FISCAL YEAR 2024 ANNUAL MONITORING PLAN

FOR

CITY AND COUNTY OF HONOLULU
MUNICIPAL SEPARATE STORM SEWER SYSTEM
NPDES PERMIT NO. HI S000002

COVERING THE PERIOD:
JULY 1, 2023 TO JUNE 30, 2024

FEBRUARY 2023 DRAFT

Prepared By:
City and County of Honolulu
Department of Facility Maintenance
Kapolei, Hawaii

BE AN EVERYDAY
CLEAN WATER
HERO

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List of Acronyms

BLS	Baseline Load Study
BMP	Best Management Practice
CASQA	California Stormwater Quality Association
City	City and County of Honolulu
Corps	United States Army Corps of Engineers (or USACE)
CWA	Clean Water Act
DFM	City and County of Honolulu, Department of Facility Maintenance
DFM-SWQ	City and County of Honolulu, Department of Facility Maintenance, Storm Water Quality Division
DLNR	State of Hawaii, Department of Land and Natural Resources
DOH	State of Hawaii, Department of Health
DOT-HWYs	State of Hawaii, Department of Transportation, Highway Division
DTS	City and County of Honolulu, Department of Transportation Services
EMC	Event Mean Concentration
ENV	City and County of Honolulu, Department of Environmental Services
EPA	United Stated Environmental Protection Agency
EOP	End-of-Pipe
EWI	Equal-Weight Increment
FWP	Focused Watershed Plan
FY	Fiscal Year
GPS	Global Positioning System
HSPF	Hydrological Stimulation Program – Fortran
I&M	Implementation and Monitoring
MEP	Maximum Extent Practicable
MFR	Multi-Family Residential
MS4	Municipal Separate Storm Sewer System

$NO_3 + NO_2$	Nitrate + Nitrite as Nitrogen
NPDES	National Pollutant Discharge Elimination System
PEAP	Program Effectiveness Assessment Plan
Permit	National Pollutant Discharge Elimination System Permit No. HI S000002
Plan	Annual Monitoring Plan
PLOAD	Pollutant Loading Estimator
Response Plan	Response Plan for Investigations and Illegal Discharges
QA	Quality Assurance
QC	Quality Control
SFR	Single Family Residential
State	State of Hawaii
SWMM	Storm Water Management Model
SWMP	Storm Water Management Program
SWMPP	Storm Water Management Program Plan
TBD	To Be Determined
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UH	University of Hawaii, Manoa
USACE	United States Army Corps of Engineers (or Corps)
USGS	United States Geological Survey
WLA	Wasteload Allocation
WRS	Weighed Risk Score

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Executive Summary

The City and County of Honolulu (City) National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit No. HI S000002 (Permit) was issued by the State of Hawaii (State), Department of Health (DOH) and became effective on September 1, 2020. The Permit will expire on August 31, 2025.

Pursuant to Part F.1(a) of the Permit, an Annual Monitoring Plan (Plan) must be submitted to the DOH by June 1st of each year for monitoring activities planned during the upcoming fiscal year (FY). This Plan covers FY24, which is the period from July 1, 2023 through June 30, 2024.

Included in this Plan is a written narrative of the proposed objectives and a description of each of the activities to be implemented over the coming fiscal year, as required by the Permit. For FY24, the City is proposing to implement ten (10) monitoring programs to address each of the requirement elements of the Permit:

1. Total Maximum Daily Load (TMDL) Wasteload Allocation (WLA) Monitoring Program
2. Receiving and MS4 Water Quality Monitoring Program
3. Dry Weather Outfall Field Screening Program
4. Watershed Water Quality Monitoring Programs
5. Bioassessment Monitoring Program
6. Palolo Stream Focused Watershed Plan
7. Trash Reduction Monitoring Plan
8. Street Sweeping Pilot Study
9. City MS4 Municipal Facilities Monitoring Program
10. Storm Water Management Program (SWMP) Effectiveness Assessment Plan

The City believes these monitoring programs will help identify and quantify the sources of many of the targeted pollutants that contribute to the impairment of water quality in the State's receiving waters in urban MS4 areas of Oahu. The long-term goal of this monitoring is to obtain more realistic TMDL WLA reductions which can be feasibly implemented to restore water quality. Through the implementation of various Best Management Practices (BMPs) and other restoration activities, including partnering with various stakeholders in the targeted watersheds, the City will be able to achieve more meaningful and sustainable water quality improvements along with complying with its Permit obligations.

The FY24 monitoring budget is estimated to be approximately $2,518,000. This budget includes the following: end-of-pipe and in-stream monitoring, development of monitoring work plans, lab analyses for water quality samples, biological assessments, development of joint monitoring agreements with the United States Geological Survey (USGS), Implementation and Monitoring (I&M) plans to address the seven (7) TMDL WLAs which the City is required to meet, BMP implementation, TMDL tracking activities, and other monitoring efforts as described in this Plan. The projected FY24 expenditures require approval from the City Council and are subject to

change, if needed, as a result of Permit negotiations and/or the need to revise City programs for better consistency with Permit requirements.

I. INTRODUCTION

The City and County of Honolulu (City) National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit No. HI S000002 (Permit) was issued by the State of Hawaii (State), Department of Health (DOH) with an effective date of September 1, 2020. The Permit and the authorization to discharge will expire on August 31, 2025.

The City's Department of Facility Maintenance (DFM) is the designated Permittee that is required to administer the NPDES MS4 program. Historically, this was done by the Department of Environmental Services (ENV) through its Storm Water Quality (SWQ) Branch. However, on July 1, 2015, the SWQ officially transferred responsibility to the DFM, which now administers the program. As of February 5, 2020, the SWQ Branch was re-designated as the SWQ Division under the DFM.

Pursuant to Part F.1(a) of the Permit, the following Annual Monitoring Plan (Plan) is being submitted to the DOH to outline the City's upcoming monitoring plans for Fiscal Year 2024 (FY24). This covers the period from July 1, 2023 through June 30, 2024.

The City's monitoring programs are designed to meet the following objectives:

Part F.1.a.(1) Assess compliance with the Permit;

Part F.1.a.(2) Measure the effectiveness of the storm water management plan;

Part F.1.a.(3) Assess the overall health of watersheds based on the chemical, physical, and biological impacts to receiving waters resulting from storm water discharges, and an evaluation of the long-term trends;

Part F.1.a.(4) Characterize storm water discharges from the MS4;

Part F.1.a.(5) Identify sources of specific pollutants;

Part F.1.a.(6) Detect and eliminate illicit discharges and illegal connections to the MS4; and

Part F.1.a.(7) Assess the water quality issues in each watershed resulting from storm water discharges from the City's MS4.

As described in the Permit, the Permittee must submit a Plan to the DOH by June 1st of each year which outlines the proposed monitoring activities for the upcoming fiscal year. The Permittee must also submit an Annual Monitoring Report to the DOH by October 31st of each year which summarizes the monitoring results during that fiscal year. The Annual Monitoring Report is included as a chapter in the Annual Report, also submitted to the DOH by October 31st.

This Plan includes a written narrative of the following items:

- Proposed objectives and description of monitoring activities;
- Description of how the monitoring results will be used to determine compliance with the Permit, specifically Part F.2 and Part F.3;
- Documentation of a plan to collect flow and rainfall characteristics, water quality parameters to be tested, and flows to be monitored;
- Documentation of the analytical methods to be used;

- Documentation of the Quality Assurance/Quality Control procedures to be used; and
- Estimated budget to be implemented over the coming fiscal year.

II. PROPOSED MONITORING PLAN FOR FY24

The overarching goal of the City's water quality monitoring program, as required under the Permit, is to manage and assess the effectiveness of its Storm Water Management Program (SWMP). The primary objective of the SWMP is to reduce, to the Maximum Extent Practicable (MEP), pollutants discharged from the City's MS4 to State receiving waters, as well as to evaluate the collected monitoring data, which can help the City make informed management decisions on how to revise the SWMP, if needed, to better meet the SWMP's primary objective. Therefore, the purpose of the monitoring program is both to meet the requirements of the Permit and to address key management questions.

Implementing an effective water quality monitoring program can also help identify water quality trends and document long-term conditions. In many cases, monitoring for storm water management purposes is coordinated with other pollutant tracking and reduction programs. For example, monitoring data may be used to support pollutant tracking and compliance with Total Maximum Daily Load (TMDL) Waste Load Allocations (WLAs), as well as to evaluate the effectiveness of programs such as public outreach, and quantify the pollutant removal rates resulting from existing Best Management Practices (BMPs) such as detention basins.

The DFM-SWQ's proposed monitoring plan for FY24 is comprised of the following ten (10) elements:

1. Total Maximum Daily Load Waste Load Allocation Monitoring Program
2. Receiving and MS4 Water Quality Monitoring Program
3. Dry Weather Outfall Field Screening Program
4. Watershed Water Quality Management Program
5. Bioassessment Monitoring Program
6. Palolo Stream Focused Watershed Plan
7. Trash Reduction Monitoring Plan
8. Street Sweeping Pilot Study
9. City MS4 Municipal Facilities Monitoring Program
10. SWMP Program Effectiveness Assessment Plan

These programs were designed to either meet the requirements of the Permit/SWMP or to track and report the City's activities as it relates to the TMDL Program. **Figure 1** is a graphical flow chart that identifies how each program element relates to the Permit. Many of the program elements are directly tied into the SWMP effectiveness program while others, such as the Bioassessment and Watershed Management Programs, are holistic approaches that help determine if the City's MS4 program has had any positive long-term water quality impacts on receiving waters.

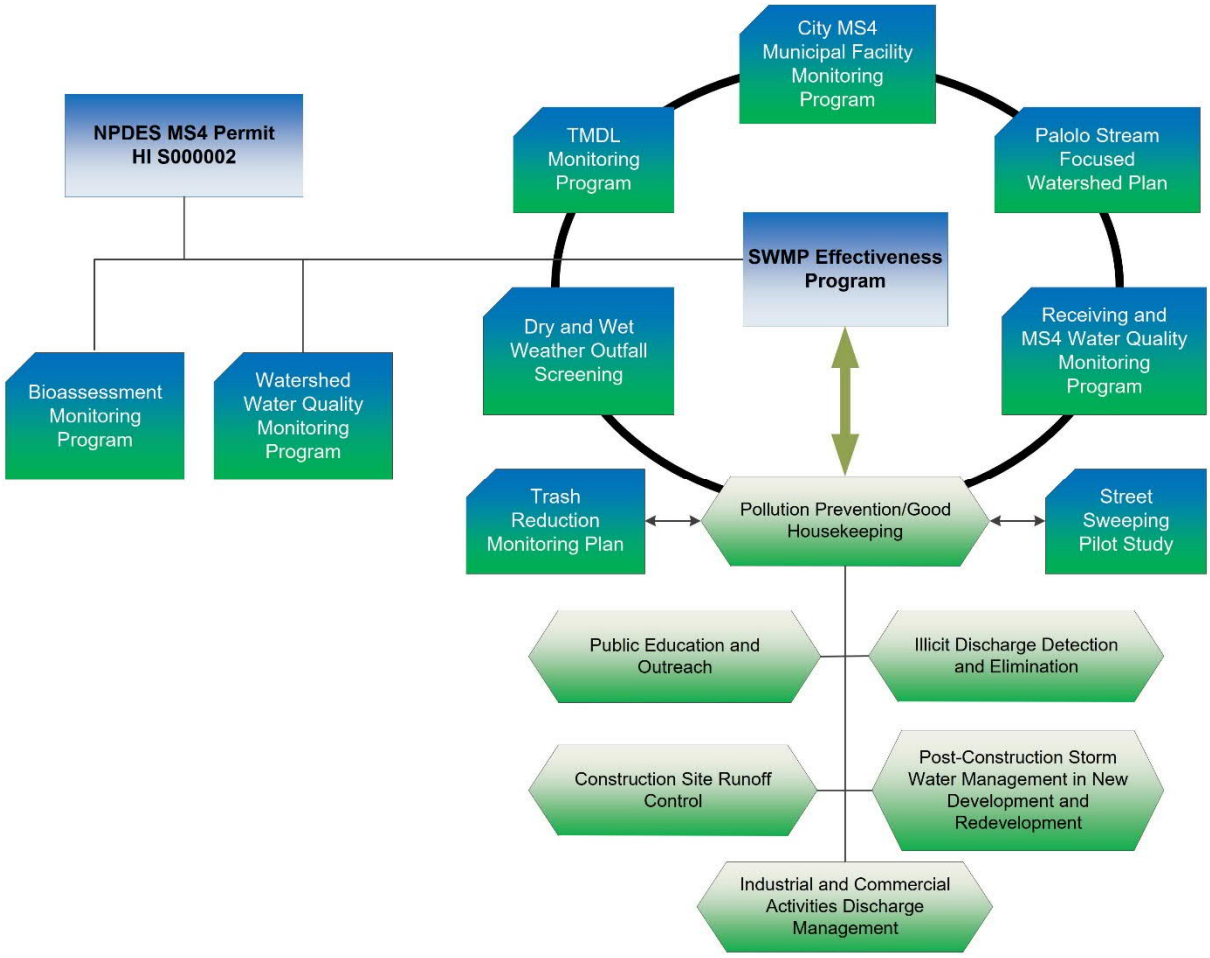


Figure 1: City NPDES MS4 Monitoring Program Flow Diagram

A. TOTAL MAXIMUM DAILY LOAD (TMDL) WASTE LOAD ALLOCATION (WLA) MONITORING PROGRAM

Part F.3.a. of the Permit requires the City to implement TMDL Implementation and Monitoring (I&M) Plans for Ala Wai Canal, Waimanalo Stream, Kapaa Stream, Kaneohe Stream, Kawa Stream, North Fork of Upper Kaukonahua Stream, and Waikele Stream.

I & M Plans typically focus on the following activities to achieve compliance with the City's WLAs:

- Public outreach efforts such as community surveys, informational flyers, volunteer cleanups, and public-private partnerships informing homeowners/businesses of how their actions affect water quality;
- Public outreach efforts targeted to specific homeowners who could make improvements around their homes such as disconnecting roof drains, sweeping their curb and gutters, reducing fertilizer usage, and implementing green infrastructure practices on their property such as rain barrels, rain gardens, and vegetative swales;

- Routine street sweeping;
- Grounds maintenance at various City facilities;
- Inspection and cleaning of drainage structures and conveyances;
- Inspection and maintenance of existing structural BMPs;
- Stream maintenance; and
- Implementing new Structural Water Quality Source and Treatment Control BMPs.

During FY23, the City submitted the final compliance report for the Waimanalo Stream watershed. Beginning in FY24 and beyond, the City will implement the activities identified in the Final Compliance Report indefinitely.

During FY24, the City will continue to implement the I&M Plans and quantify the pollutant load reductions needed to comply with the City's remaining WLAs. In addition, the City is preparing to submit a petition to the U.S. Environmental Protection Agency (U.S. EPA) to revise the City's WLA load reductions by incorporating updated precipitation information, site-specific water quality data, and other relevant modifications. If the petition is accepted in part or in whole, the City's WLA load reductions may change.

While the U.S. EPA petition is pending, the DFM-SWQ will continue to work jointly with other stakeholders to facilitate the I & M Plans in the impaired TMDL watersheds for the purpose of meeting the required WLA load reductions. Possible stakeholders include the State Department of Transportation, the University of Hawaii, the State Department of Land and Natural Resources (DLNR), the U.S. Army, the U.S. Navy, the U.S. Department of Agriculture, the State Department of Education, and/or private companies and landowners, depending on what other permittees have been identified in a particular watershed. The goal of collaboration is to implement specific water quality improvement activities to reduce the pollutants that are identified in each of the respective TMDL reports and demonstrate compliance with the WLAs.

The City is also considering the development and implementation of a Water Quality Credit Trading Program to meet its regulatory obligations. This would involve purchasing equivalent or higher pollutant load reductions from another agency or stakeholder which can implement pollution control measures in off-site areas at a lower cost. Trading allows for potentially significant cost savings by enabling permittees the flexibility to implement technologies and land use practices in a less expensive location, while still meeting their regulatory requirements. Water quality credit trading has the additional benefit of encouraging the public, who are otherwise not obligated to comply with pollution reduction measures, to voluntarily remove non-point source loads that are contributing to the impairment of the water body. The U.S. EPA is a strong supporter of water quality trading to reduce pollutant loads, including sediment and nutrients which are applicable to the TMDL watersheds.

B. RECEIVING AND MS4 WATER QUALITY MONITORING PROGRAM

1) In-Stream Baseline Grab Sampling

Beginning in 1997, the ENV (now DFM-SWQ) began taking monthly in-stream grab samples from Manoa, Waihi, and Waiakeakua Streams, the primary streams that flow through the Manoa Watershed. The monthly samples were collected at the same location in each stream and were

analyzed at a laboratory for the following water quality parameters: Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Kjeldahl Nitrogen (TKN), Nitrate+Nitrite as Nitrogen (NO_3+NO_2 as N), Total Nitrogen (TN), Total Phosphorus (TP), Specific Conductivity, Turbidity, Dissolved Oxygen, pH, and water temperature, as required by the City's MS4 Permit.

In FY10, the ENV modified its stream sampling approach to focus the majority of its sampling resources towards the State's TMDL program. Sampling sites were selected based off the three (3) initial TMDL approved watersheds, which included the Ala Wai Canal, Kawa Stream, and Waimanalo Stream watersheds. Grab samples were collected and analyzed for nutrients and TSS, and additional parameters were measured in the field using a YSI EXO3 Multi-Parameter Water Quality Sonde. The DFM-SWQ continues to focus its in-stream water quality monitoring activities in those three (3) areas. Additional data collection began in Kapaa Stream starting in FY11 followed by Kaneohe Stream in FY14.

During FY24, the DFM-SWQ will continue to collect water quality samples in each of the TMDL watersheds, except the North Fork of Upper Kaukonahua Stream and Waikele Stream due to a lack of accessible sampling locations. In total, 29 sites in 7 TMDL watersheds will be sampled, as shown in **Table 1**. Maps of the sampling sites are shown in **Figure 2** through **Figure 8**, and are also referenced in Table 1 for each stream. The sites were determined based on accessibility and the ability to collect a representative sample. The sampling will be quarterly, not monthly, due to the increased number of sampling locations and the limited availability of personnel. At least two (2) representative samples will be collected from each stream site during each of the wet and dry seasons. Samples will be collected during either baseflow or stormflow conditions in the stream, depending on the weather at the time of sampling. The same water quality parameters identified above will be monitored during each sampling event, in addition to ammonia nitrogen. If there was rain on the sampling day, the total rainfall depth, duration, location, and storm event return time will also be documented, along with visual observations of the stream conditions (e.g. presence of floatables, deposits, color, etc.).

Table 1: In-Stream Baseline Grab Sampling Points

Station ID	Location Description	GPS Coordinates
Manoa Stream (# of Sampling Points: 7) [See Figure 2]		
Manoa #1	Bridge at end of Private Road near Waaloa Way	21°19'42.468"N (Latitude) 157°47'57.748"W (Longitude)
Manoa #2	Bridge at end of Waaloa Way	21°19'42.285"N (Latitude) 157°48'2.789"W (Longitude)
Manoa #3	Bridge at Private Road near end of Waakua Street	21°19'38.877"N (Latitude) 157°48'2.004"W (Longitude)
Manoa #4	Bridge at Manoa District Park entrance and end of Kahaloa Drive	21°18'48.837"N (Latitude) 157°48'23.471"W (Longitude)
Manoa #5	Bridge at Woodlawn Drive	21°18'28.909"N (Latitude) 157°48'32.89"W (Longitude)
Manoa #6	Near Old USGS Sampling Station at Kanewai Field	21°17'35.862"N (Latitude) 157°48'45.73"W (Longitude)
Manoa #7	Bridge at Kapiolani Boulevard (Mauka Side)	21°17'18.479"N (Latitude) 157°49'1.006"W (Longitude)
Makiki Stream (# of Sampling Points: 3) [See Figure 3]		
Makiki #1	Near BWS Makiki Pump Station at Makiki Heights Drive	21°18'35.182"N (Latitude) 157°49'49.78"W (Longitude)
Makiki #2	Wilder Street near Poki Street	21°18'12.783"N (Latitude) 157°50'1.28"W (Longitude)
Makiki #3	Near Corner of King Street and Kalakaua Avenue	21°17'49.422"N (Latitude) 157°50'12.043"W (Longitude)
Palolo Stream (# of Sampling Points: 5) [See Figure 4]		
Palolo #1	End of Palolo Place	21°18'24.058"N (Latitude) 157°47'17.641"W (Longitude)
Palolo #2	Bridge at 10th Avenue	21°18'4.814"N (Latitude) 157°47'24.94"W (Longitude)
Palolo #3	Bridge at Kiwila Street	21°17'58.248"N (Latitude) 157°47'38.862"W (Longitude)
Palolo #4	Bridge at Entrance to Chaminade University	21°17'18.545"N (Latitude) 157°48'32.591"W (Longitude)
Palolo #5	Koali Road before Confluence to Manoa Stream	21°17'26.323"N (Latitude) 157°48'51.908"W(Longitude)
Kawa Stream (# of Sampling Points: 3) [See Figure 5]		
Kawa #1	Drainage Channel at Mokulele Drive near Kumakua Place	21°23'44.95"N (Latitude) 157°47'35.315"W (Longitude)

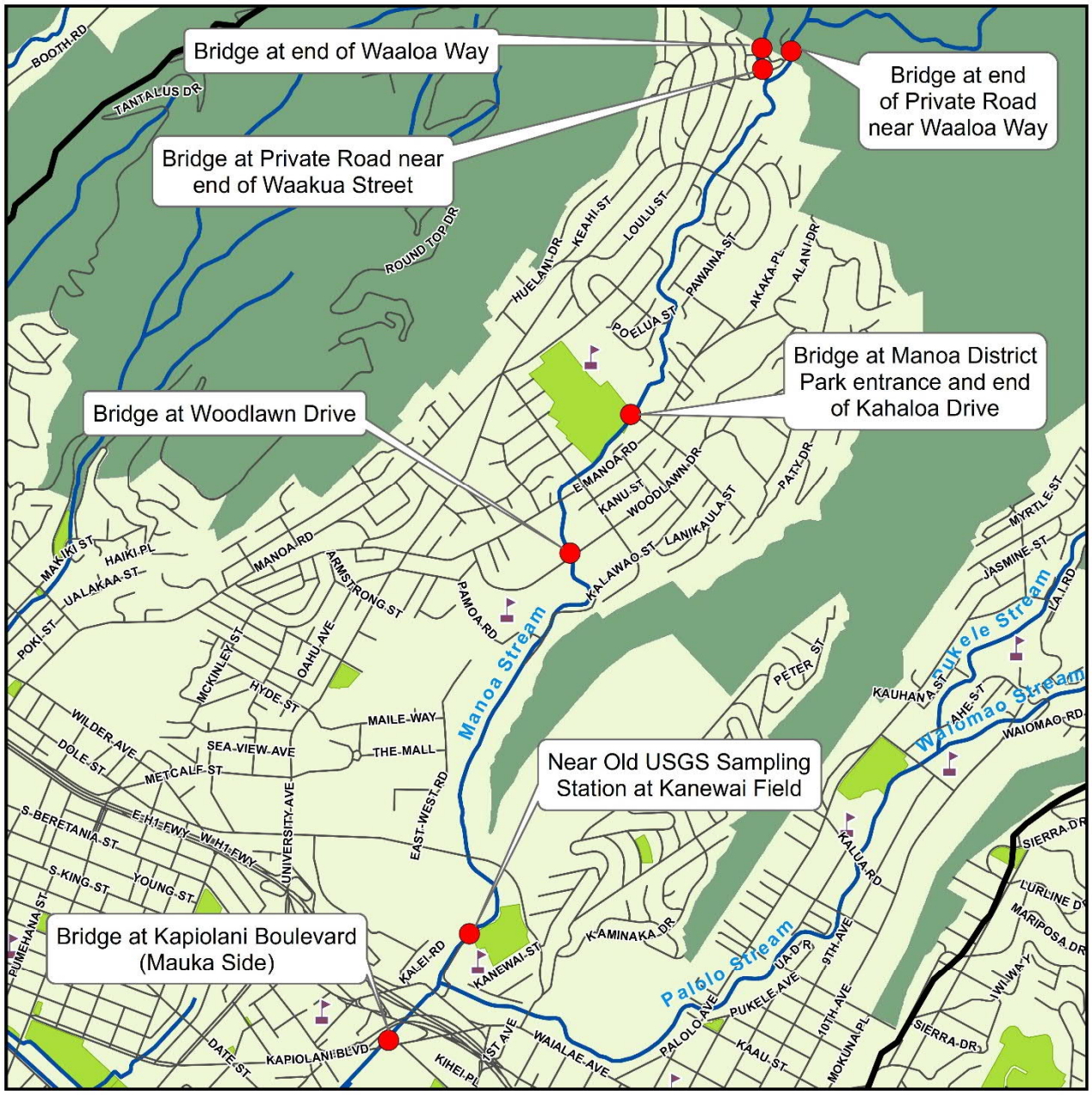
Table 1: In-Stream Baseline Grab Sampling Points (Continued)

Station ID	Location Description	GPS Coordinates
Kawa Stream (# of Sampling Points: 3) [See Figure 5]		
Kawa #2	Drainage Easement Upstream of Bridge at Namoku Street*	21°23'58.754"N (Latitude) 157°47'28.09"W (Longitude)
Kawa #3	Open Lot Before Bridge at Kaneohe Bay Drive	21°24'20.117"N (Latitude) 157°47'26.89"W (Longitude)
Waimanalo Stream (# of Sampling Points: 6) [See Figure 6]		
Waimanalo #1	Drainage Ditch near Olomana Gardens	21°20'28.081"N (Latitude) 157°44'42.483"W (Longitude)
Waimanalo #2	Drainage Ditch upstream of Waikupanaha Street	21°20'18.345"N (Latitude) 157°44'10.431"W (Longitude)
Waimanalo #3	Bridge on Private Road at 41-659D Kumuhau Street	21°20'45.924"N (Latitude) 157°44'5.226"W (Longitude)
Waimanalo #4	Drainage Ditch near 41-1612 Koa Moali Place	21°20'39.009"N (Latitude) 157°43'35.59"W (Longitude)
Waimanalo #5	Downstream of Bridge along Kalanianaole Hwy near Mekia Street	21°20'53.682"N (Latitude) 157°43'22.976"W (Longitude)
Waimanalo #6	Upstream of Bridge at Saddle City Road	21°21'10.446"N (Latitude) 157°43'26.764"W (Longitude)
Kapaa Stream (# of Sampling Points: 1) [See Figure 7]		
Kapaa #1	At Bend and Downstream of Kapaa Quarry Road	21°24'12.452"N (Latitude) 157°45'59.343"W (Longitude)
Kaneohe Stream (# of Sampling Points: 4) [See Figure 8]		
Kaneohe #1	At Hoomaluhia Botanical Garden Road	21°23'30.394"N (Latitude) 157°48'34"W (Longitude)
Kaneohe #2	Bridge at Luluku Road	21°23'57.067"N (Latitude) 157°48'9.052"W (Longitude)
Kaneohe #3	At Anoi Road	21°24'36.152"N (Latitude) 157°48'16.701"W (Longitude)
Kaneohe #4	At the back of Kaneohe Neighborhood Park	21°24'42.405"N Latitude) 157°47'54.262"W (Longitude)
Upper Kaukonahua Stream (# of Sampling Points: 0)**		
Waikele Stream (# of Sampling Points: 0)**		

* If sampling is conducted during rain events and stormflow is observed from outfalls near Namoku Street bridge, samples may be collected downstream of bridge as long as sampling at that location can be completed without compromising grab samples.

**No sampling points proposed for Upper Kaukonahua Stream and Waikele Stream due to sampling points being inaccessible

Location maps are included on the following pages that indicate the locations of each of the proposed YSI and grab sample points for each TMDL receiving water as shown in **Figures 2 through 8**.



Department of Facility Maintenance
Storm Water Quality Division
May 2021

Figure 2: Manoa Stream Sampling Points

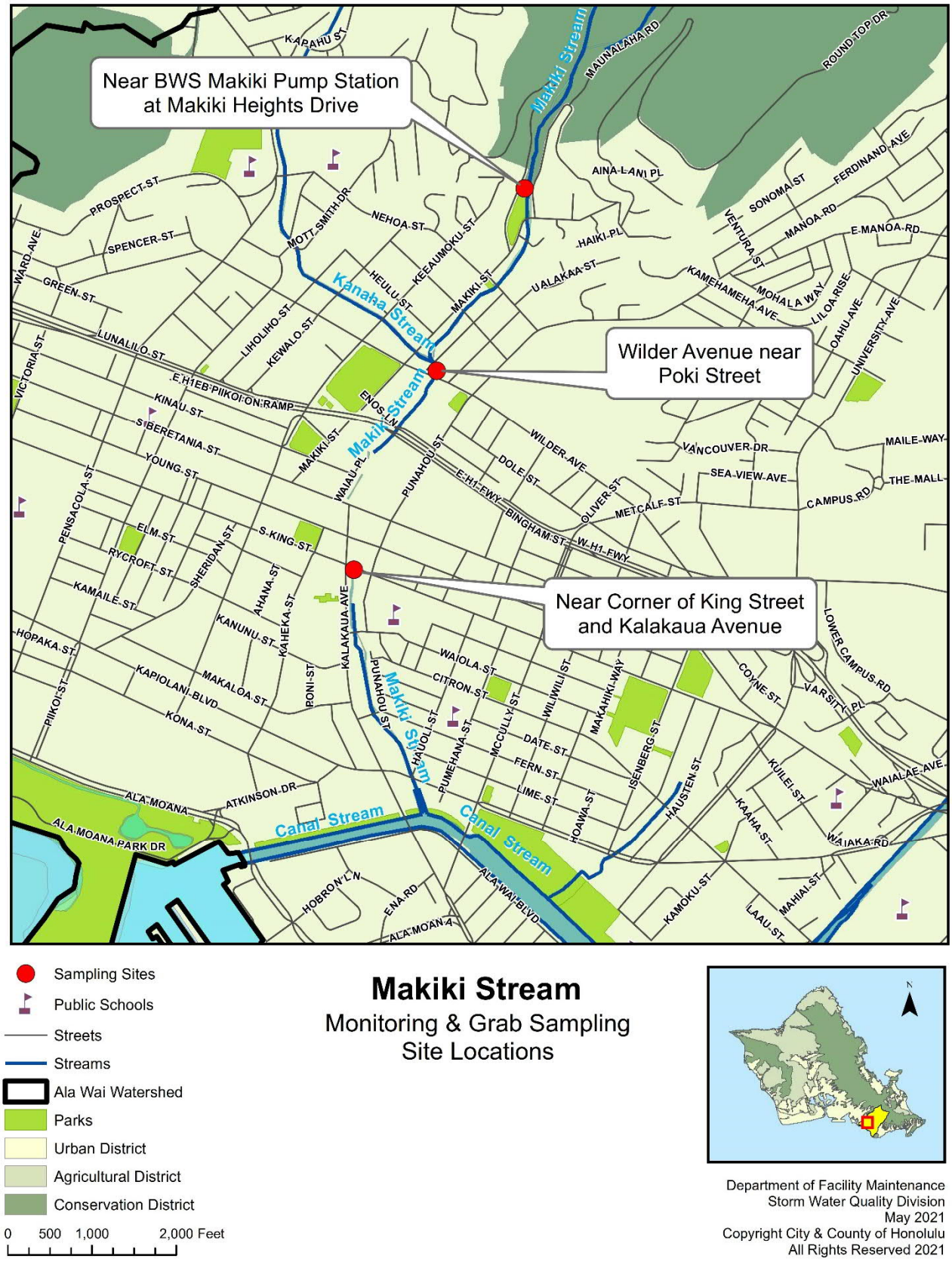


Figure 3: Makiki Stream Sampling Points

Figure 4: Palolo Stream Sampling Points

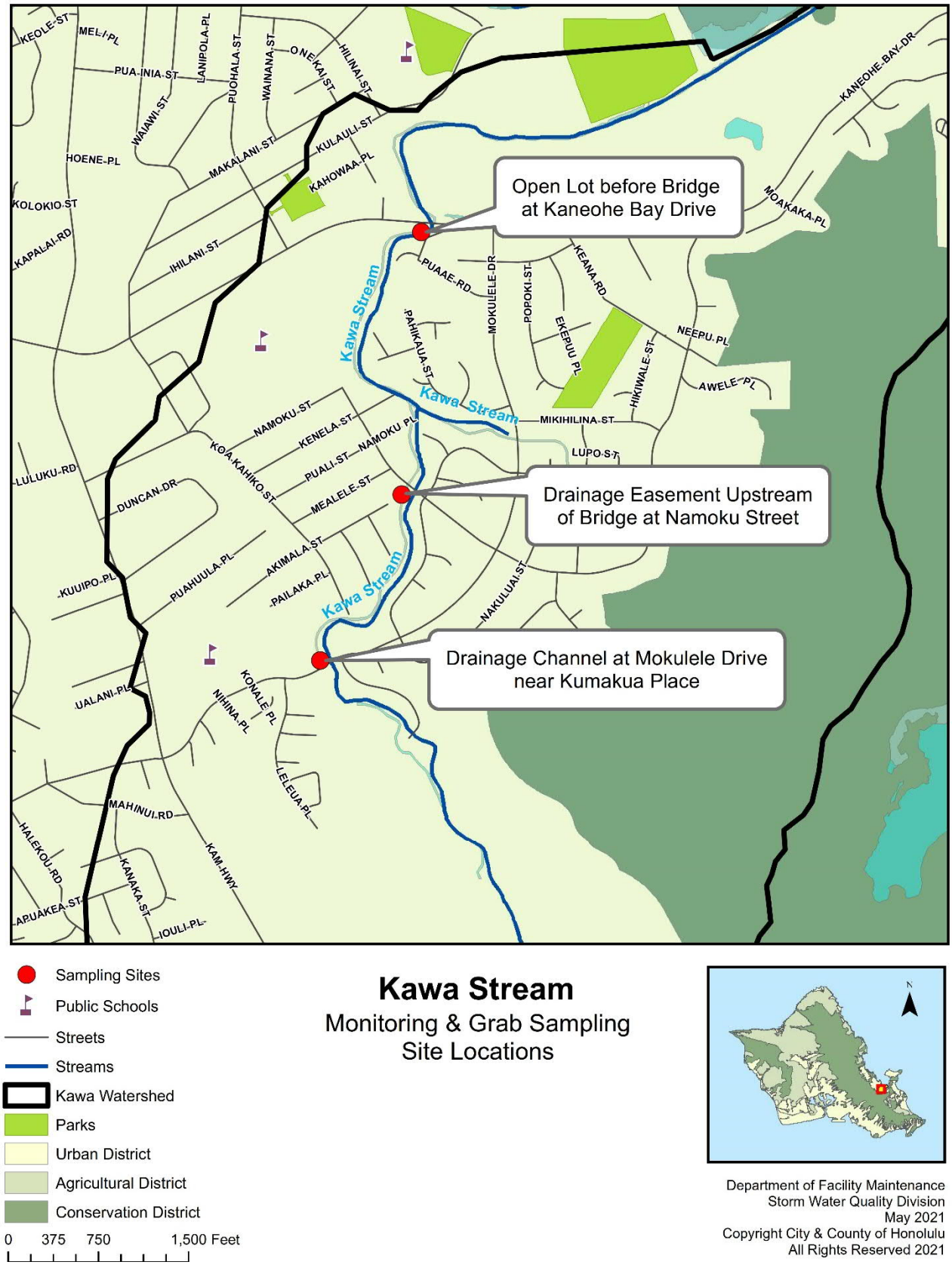


Figure 5: Kawa Stream Sampling Points

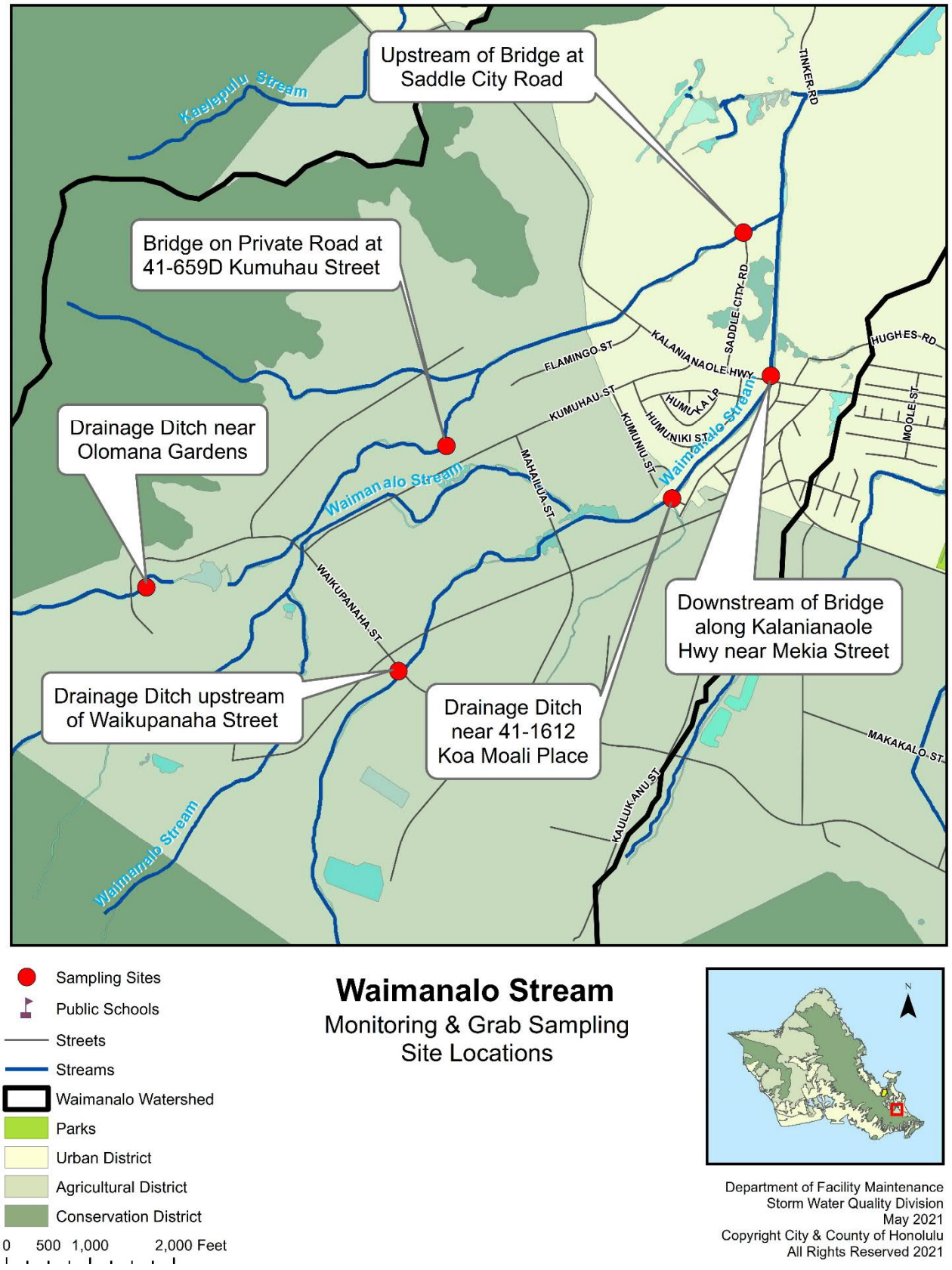


Figure 6: Waimanalo Stream Sampling Points

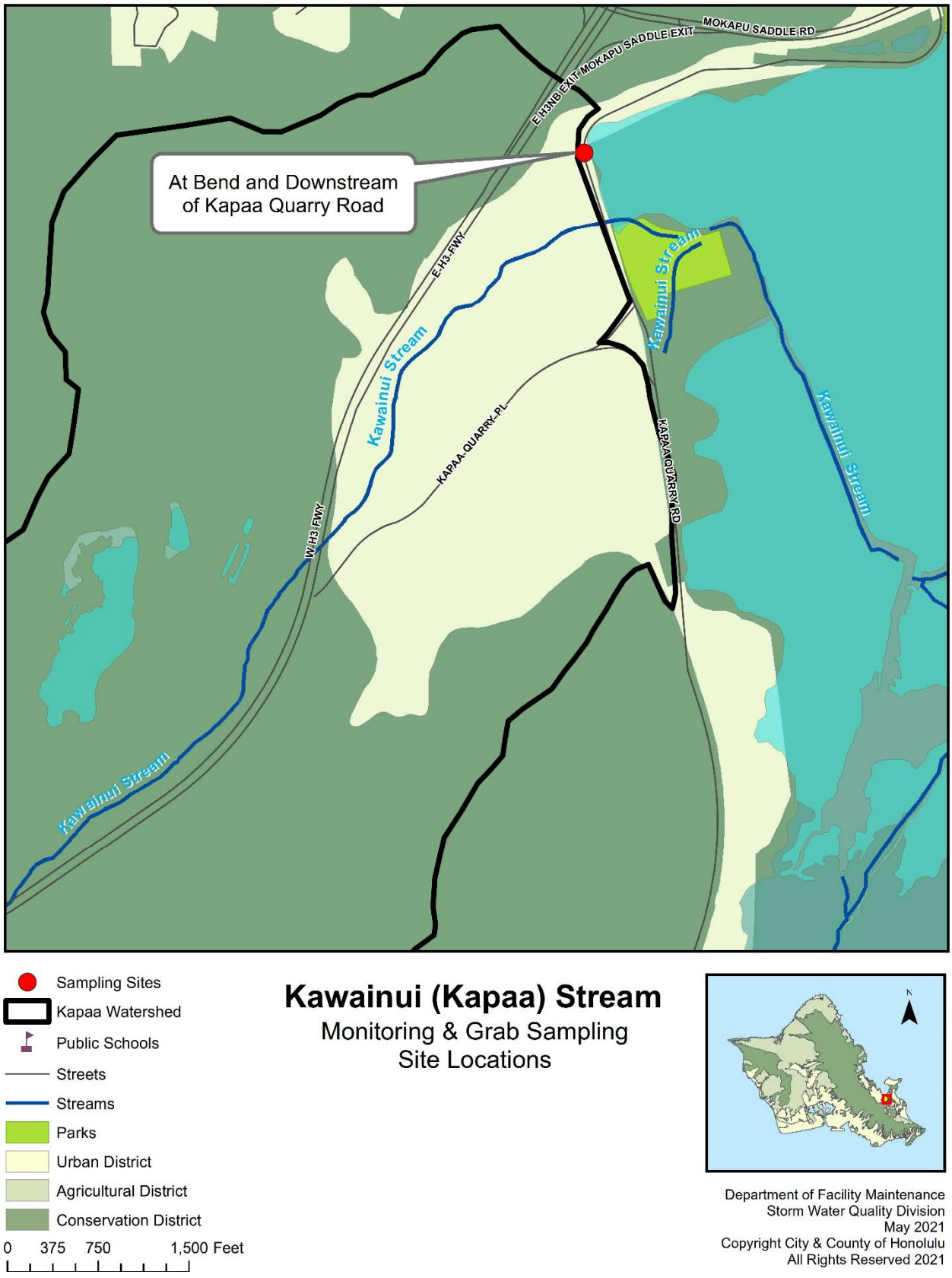


Figure 7: Kapaa Stream Sampling Points

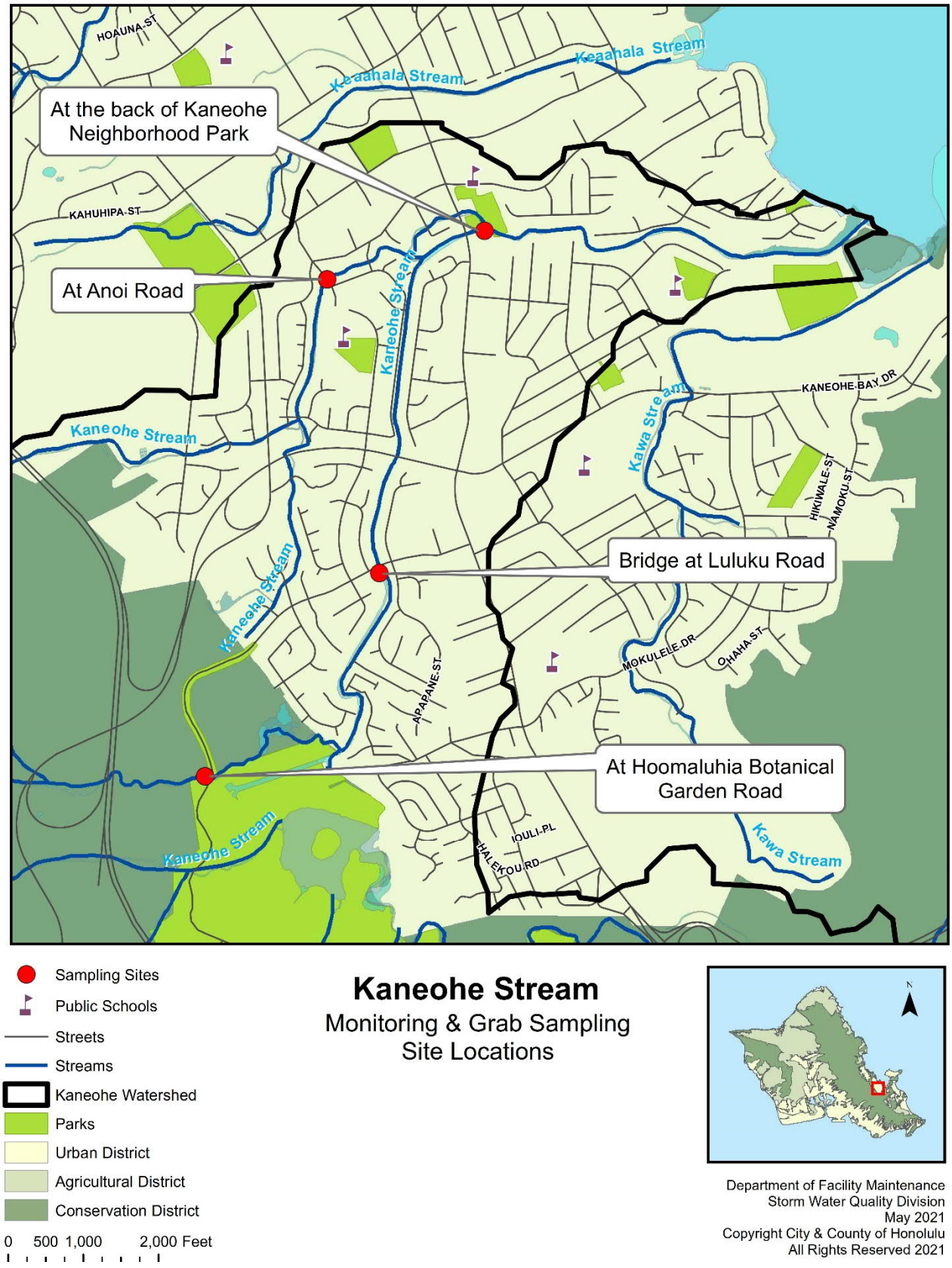


Figure 8: Kaneohe Stream Sampling Points

2) In-Stream Automated Sampling

The DFM-SWQ also operates and maintains fixed in-stream water quality monitoring stations in select impaired streams listed on the DOH's Section 303(d) list of Water Quality-Limited Segments. The purpose of the in-stream monitoring is to determine the impact of the City's MS4 storm discharges on the existing water quality of receiving streams. The collected stream data may also be used for a number of other purposes, for example TMDL WLA tracking, calibrating watershed pollutant models, and helping to inform BMP planning and implementation.

To date, three streams have been monitored in Pearl City, Manoa, and Ahuimanu. Both upstream and downstream locations were monitored in each stream to evaluate changes in water quality along the length of the stream resulting from urban MS4 inputs between the upstream and downstream sites. Monitoring in these streams was completed in FY17, FY18, FY22, and FY23, respectively, as shown in **Table 2**.

In-stream monitoring is currently inactive and no new sites are planned for FY24, although additional sites may potentially be monitored in the future. However, in-stream monitoring is expected to be a major component of the Palolo Stream Focused Watershed Plan. This is discussed separately in Section II.F.

Table 2: In-Stream Monitoring Locations

Site No.	Location	Status	Comments
1	Pearl City Upstream	Completed	Monitoring concluded in FY17
2	Pearl City Downstream	Completed	Monitoring concluded in FY17
3	Manoa Upstream	Completed	Monitoring concluded in FY18
4	Manoa Downstream	Completed	Monitoring concluded in FY18
5	Ahuimanu Downstream	Completed	Monitoring concluded in FY22
6	Ahuimanu Upstream	Completed	Monitoring concluded in FY23
7	TBD	n/a	Additional sites may be initiated in future years

3) End-of-Pipe (EOP) Automated Sampling

The DFM-SWQ will continue to operate an EOP monitoring program in FY24 to collect storm Event Mean Concentrations (EMCs) for representative land uses draining to the City's MS4. Each EOP location will be monitored for two years if funding allows. The EMC data are expected to closely represent Oahu-specific land uses over a wide range of rainfall/runoff conditions. Upcoming land uses to be monitored in FY24 include open space (e.g. parks and golf courses) and institutional (e.g. schools and hospitals).The Quality Assurance Project Plan for the EOP monitoring is included in **Appendix G**.

To date, a total of seventeen (17) EOP sites have been monitored from FY13 to FY23 and are no longer operational. These sites include:

- Nine (9) EOP Single-Family Residential (SFR) locations (two in Wahiawa; and one in each of Pearl City, Manoa, Palolo, Waialae Iki, Kaneohe, Kawa, and Ahuimanu),
- Two (2) EOP BMP effectiveness locations in Mililani,
- Three (3) Multi-Family Residential (MFR) locations (one in each of Waipahu, Aiea, and Ahuimanu), and
- Three (3) industrial locations (one in each of Halawa, Pearl City, and Campbell Industrial Park).

A full list of all the completed EOP sites is provided in **Table 3**.

Upcoming EOP monitoring sites for FY24 include one (1) institutional site at Mililani Mauka Elementary School (shown in **Figure 9)** and one (1) open space site at Waiau District Park in Pearl City (shown in **Figure 10**). These sites were identified through a GIS desktop analysis and field feasibility survey and are considered suitable for the collection of representative storm EMCs to characterize the targeted land uses. Each site will be monitored for two years (FY24 to FY26) if funding allows. **Figure 11** shows the location of all completed and future FY24 EOP monitoring locations.

The two FY24 EOP sites will be equipped with various monitoring equipment for the collection of storm samples and the measurement of rain and flow in the MS4 pipe. This will include the following:

- Automated Teledyne ISCO Avalanche Portable Refrigerated sampler,
- Teledyne ISCO Signature Flow Meter
- Teledyne ISCO Bubbler or 310 Ultrasonic Level Sensor
- Hydrological Services Model TB4 tipping bucket rain gauge,
- High-capacity 12-V sealed lead acid battery, and
- 90-watt solar panel.

The Signature Flow Meter has a built-in cellular modem to allow sampling personnel to access the monitoring data and trigger the sampling remotely. Depending on site conditions, the physical set-up of the sampling equipment may vary. The parameters to be monitored include TSS, turbidity, TKN, TN, NO_3+NO_2 as N, Ammonia Nitrogen as N (NH_3-N), Organic Nitrogen, TP, and total metals (lead, copper, and zinc). Weather permitting, it is anticipated that samples will be collected during both the wet and dry seasons in sufficient quantity to allow a meaningful analysis of the data.

All of the EMC data collected in FY24 will be included in annual monitoring reports submitted to the DOH in October of each fiscal year. The EMC data may also be used for a number of other City applications, for example:

- Permanent BMP Planning tool;
- Reference data for watershed modeling, trend analysis, and development/enforcement of storm water regulations;

- Tool used to identify pollutant sources in storm water;
- Tool used to identify pollutant "hot spots" or problem areas and to develop subsequent solutions;
- Tool used to prioritize outreach and education efforts;
- Tool used to assist other stakeholders in watershed planning; and
- Development of future TMDL/WLAs

Table 3: End-of-Pipe Monitoring Locations

Site No.	Location	Land Use	Status	Comments
1	Upper Wahiawa	SFR	Completed	Completed in FY13
2	Upper Wahiawa	SFR	Completed	Completed in FY13
3	Pearl City	SFR	Completed	Completed in FY17
4	Manoa	SFR	Completed	Completed in FY18
5	Mililani	BMP Effectiveness	Completed	Completed in FY18
6	Mililani	BMP Effectiveness	Completed	Completed in FY18
7	Waipahu	MFR	Completed	Completed in FY21
8	Aiea	MFR	Completed	Completed in FY20
9	Palolo	SFR	Completed	Completed in FY20
10	Waialae Iki	SFR	Completed	Completed in FY20
11	Kaneohe	SFR	Completed	Completed in FY20
12	Halawa	Industrial	Completed	Completed in FY20
13	Pearl City	Industrial	Completed	Completed in FY21
14	Kawa	SFR	Completed	Completed in FY21
15	Ahuimanu	SFR	Completed	Completed in FY22
16	Ahuimanu	MFR	Completed	Completed in FY22
17	Campbell	Industrial	Completed	Completed in FY23
18	Pearl City Waiau District Park	Open Space	Pending	Expected to Begin Monitoring in FY24
19	Mililani Mauka Elementary School	Institutional	Pending	Expected to Begin Monitoring in FY24

Figure 9: Mililani Mauka Elementary School EOP Institutional Sampling Point

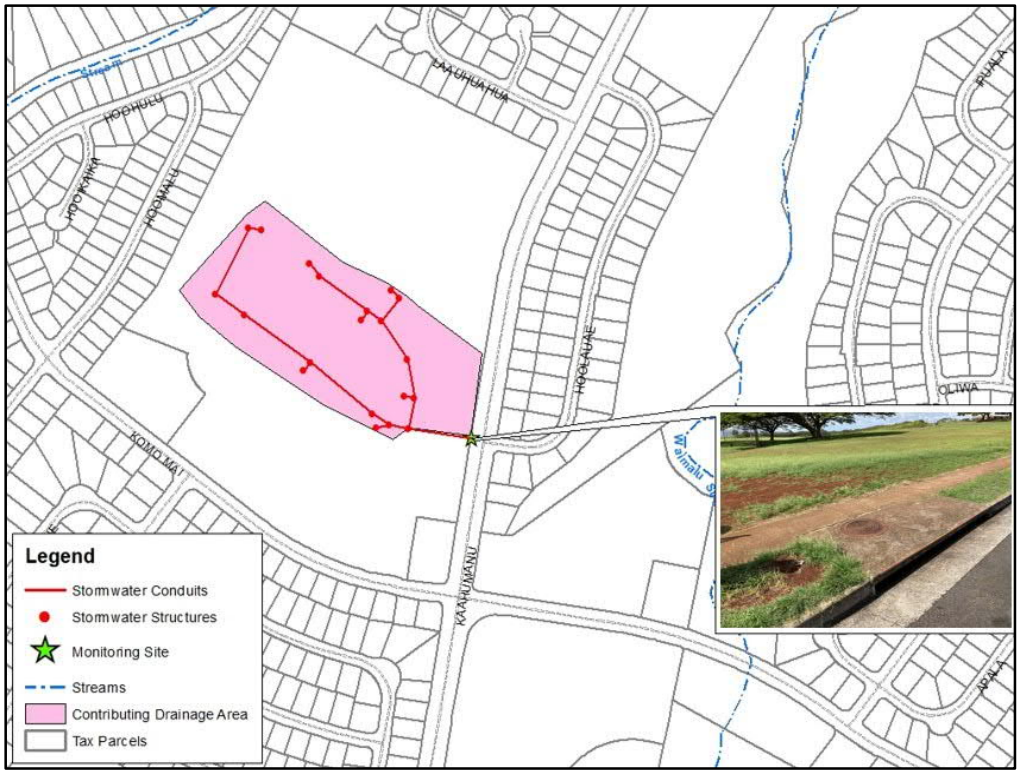


Figure 10: Pearl City Waiau District Park EOP Open Space Sampling Point

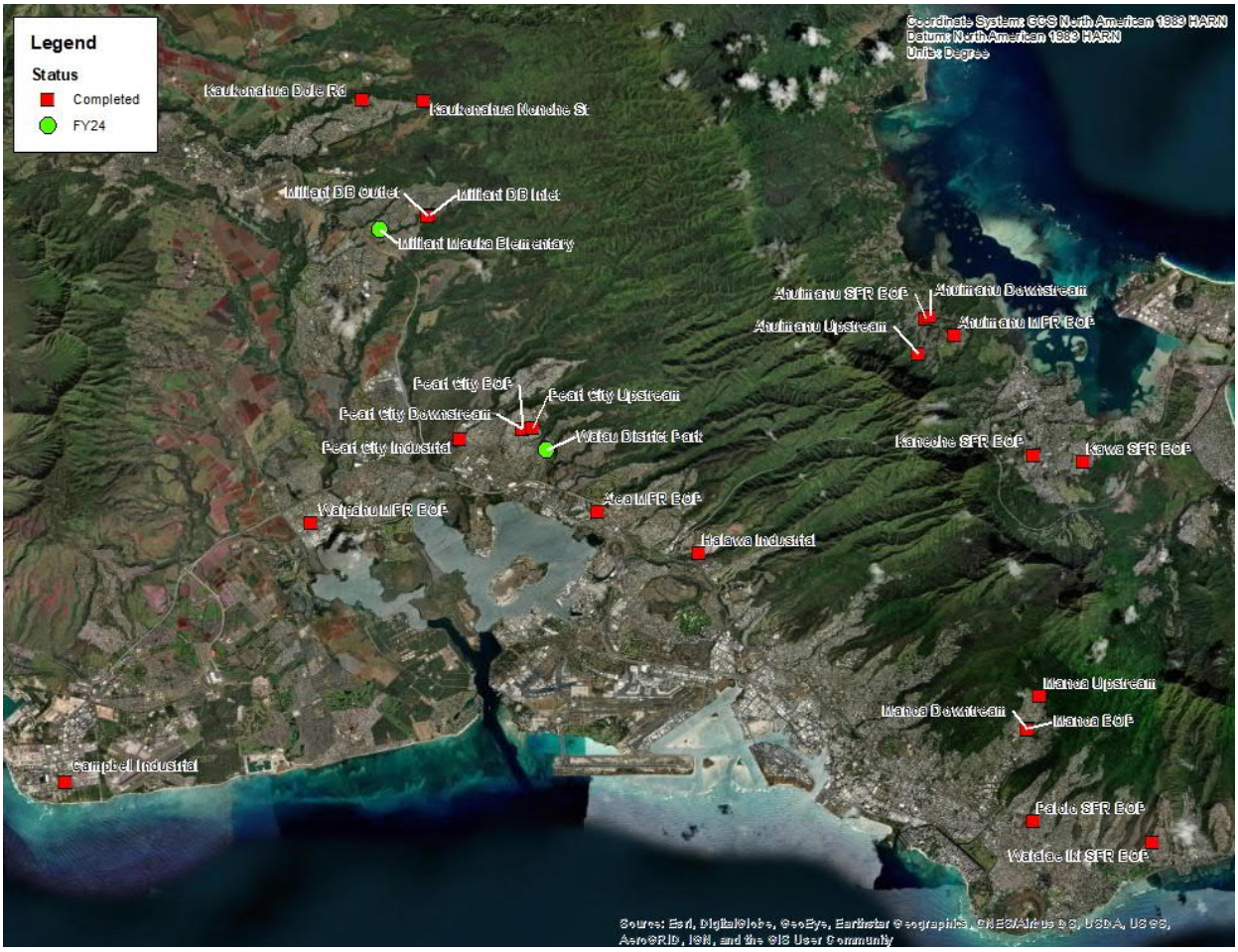


Figure 11: End-of-Pipe and In-Stream Monitoring Stations

4) Long-Term Mass Loading Receiving Water Sampling

The DFM-SWQ has a number of long standing cost-sharing agreements with the USGS to operate and maintain permanent stream gauging stations in various watersheds across the island. The objective of this monitoring is to provide the City with stormwater water quality data and stream flow data with the ultimate goal of calculating long-term sediment mass loading in the monitored streams.

The stream gauging stations are primarily located in priority watersheds with an approved TMDL, including the Ala Wai Canal, Waimanalo Stream, Kawa Stream, Kaneohe Stream, and Kapaa Stream. The USGS collects long term continuous measurements of stream flow and turbidity in these streams. In addition, nutrient and sediment samples are collected manually and via automated samplers. The City's current monitoring agreement with the USGS is scheduled to run through September 30, 2024. It is expected that this joint-funding agreement will be extended through the next permit period that would run from 2025-2030, pending availability of funds. Contract negotiations are currently underway and being discussed. As part of this discussion, there has been considerations to include future TMDL watersheds such as Keehi Lagoon that would include both Moanalua Stream and Keehi Stream.

The DFM-SWQ will also continue to work with the USGS in other watersheds such as Waikele Stream, Honouliuli Stream, and Kaloi Gulch. This monitoring was initiated in FY17 and was originally scheduled to conclude on September 30, 2021. However, due to the COVID-19 pandemic and delays in the installation of these monitoring stations, the USGS recently proposed to extend these agreements through September 30, 2026 at no additional cost. These watersheds primarily consist of agricultural and conservation lands but are starting to urbanize over time. The DFM-SWQ is closely tracking water quality in these watersheds to identify any possible changes resulting from this increasing urbanization. Once these agreements have expired, it is anticipated that Waikele Stream will be merged into the aforementioned TMDL watershed agreement while Honouliuli Stream and Kaloi Gulch will be discontinued.

Additionally, the USGS and DFM-SWQ are actively discussing future plans for its Kaukonahua Stream monitoring agreement that expired on September 30, 2021. The State DLNR has expressed interest in partnering with the City and the USGS on cost sharing the expenses to continue monitoring in this watershed. A cooperative agreement is being drafted and expected to allow for a multi-year extension through at least FY25 and an option for a new 5-year agreement to run through 2030, pending availability of funding.

Table 4 below is a summary of both active and inactive USGS stream gauging stations in ten (10) different watersheds for the measurement of long-term annual sediment loads. Also shown is the monitoring durations for each station. The locations of these stations are shown in **Figure 12** through **Figure 18**, which are also referenced in **Table 4**.

Table 4: Long-Term Sediment/Flow Sampling Locations

Waterbody/Stream	No. of Gauging Stations	Duration*
Ala Wai (**Figures 12 and 13**)	4	June 1, 2015 – Sept. 30, 2024
Waimanalo	1	June 1, 2015 – Sept. 30, 2024
Kaneohe	1	Oct. 1, 2016 – Sept. 30, 2024
Kawa	1	Oct. 1, 2016 – Sept. 30, 2024
Kapaa	1	Oct. 1, 2016 – Sept. 30, 2019
Kaukonahua (**Figures 14 and 15**)	4	June 1, 2017 – Sept. 30, 2021**
Honouliuli/Kaloi (**Figures 16 and 17**)	4 (2 active)	June 1, 2017 – Sept. 30, 2026
Waikele (**Figure 18**)	3 (2 active)	June 1, 2017 – Sept. 30, 2026
Kaelepulu	6	March 1, 2014 – Dec. 31, 2017
Salt Lake	9 2	June 1, 2015 – May 31, 2016 June 1, 2016 – June 30, 2017

* Pending budget approval for future years beyond FY25

** Subject to change, pending outcome of ongoing contract negotiations with USGS

In general, under the various long-term monitoring agreements developed with DFM-SWQ, the following specific elements for the proposed work are as outlined below:

- Obtain necessary permits and right-of-entry for new gauges;
- Construct and install new gauge equipment to measure continuous streamflow and sediment concentrations at all agreed upon sampling stations;
- Collect on a continuous basis streamflow discharge measurements and stage-discharge verifications for all agreed upon sampling stations;
- Analyze representative samples for suspended-sediment concentrations for all sampling stations including City provided refrigerated automatic samplers;
- Selected suspended-sediment samples will have additional analysis to determine the percent concentration finer than sand to ensure the automatic sampler intake is properly located and to help understand the nature of the material transported;
- Analyze relationship between turbidity and suspended-sediment concentrations to determine if turbidity is a reliable surrogate for suspended-sediment concentration;
- Compute annual suspended sediment loads for all monitoring sites based off representative samples characterized by specific land uses and drainage areas; and
- Collect quarterly samples manually and with refrigerated automatic samplers, and analyze for selected nutrient concentrations and total suspended solids. First-flush and flow-weighted, time composite results will be provided.

By gathering both continuous stream measurements for flow and sediments and computing annualized sediment loads, it will allow DFM-SWQ to gain a better understanding of the major impacts on water quality and evaluate long term trends.

Long term sampling will be in cooperation with several existing and potential partners, including the State Department of Transportation, Highway Division (DOT-HWYs), University of Hawaii at Manoa (UH), U.S. Army Corps of Engineers (Corps or USACE), and the USGS. The discussion will focus on determining additional sampling and gaging stations, as necessary, and will include monitoring parameters to be sampled, sampling locations, and targeted land uses to be monitored. The discussion will also include potential cost sharing opportunities. The DFM-SWQ believes that the Corps and the USGS will be instrumental in providing the technical and field expertise necessary when gathering the intended water quality data to be used towards developing pollutant loads and identifying the sources of these pollutants.

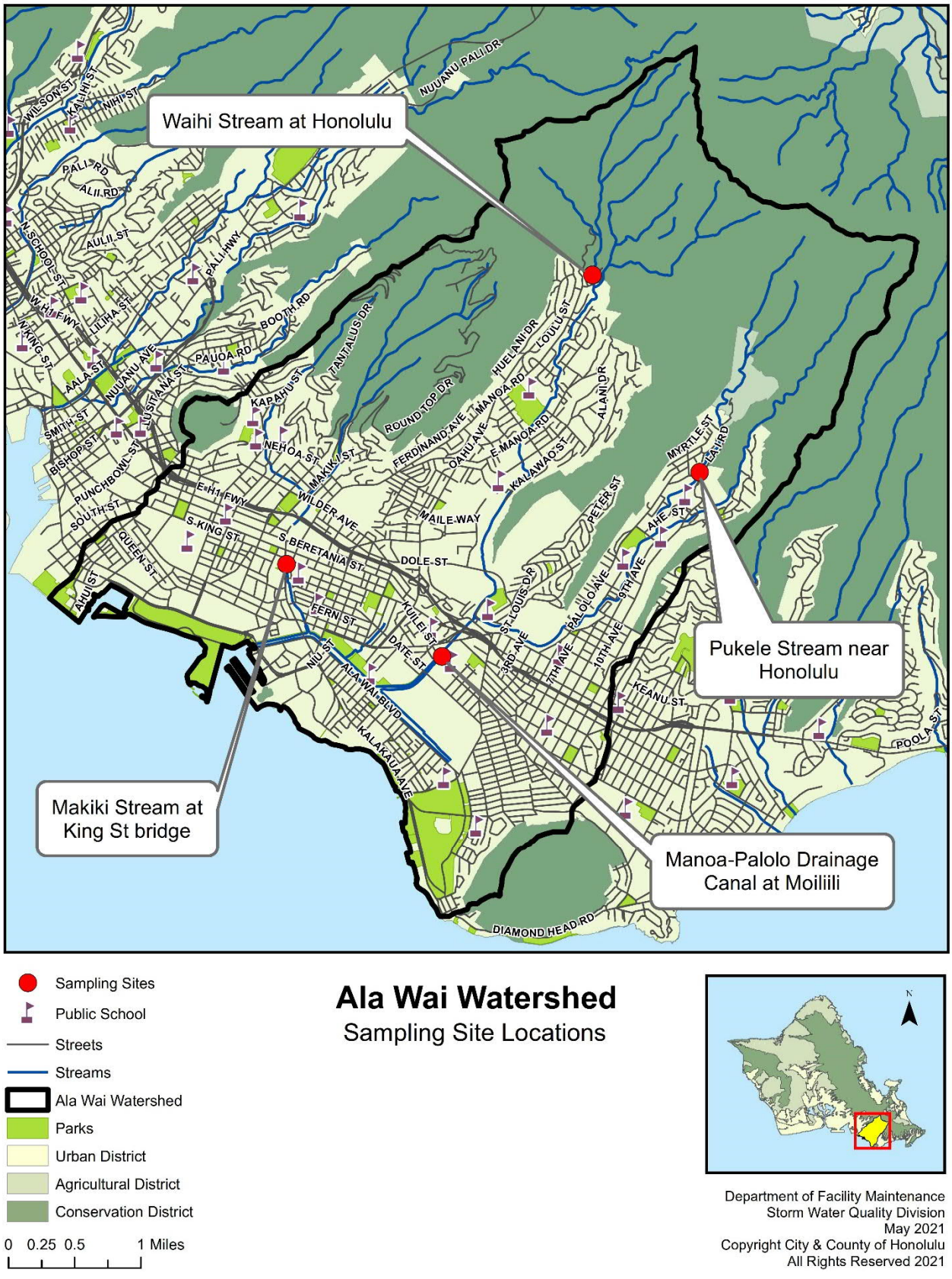


Figure 12: Ala Wai Watershed Sampling Site Locations

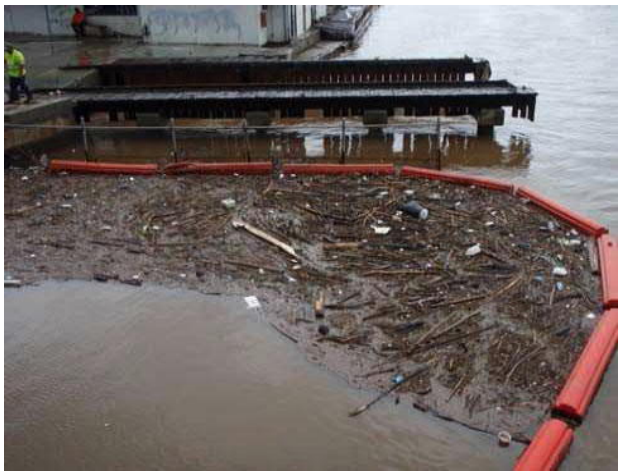
Waihi Stream (Upper Manoa) Wet Weather

Manoa Stream (USGS Gage Station) Wet Weather

Manoa Stream (Channelized Portion) Wet Weather

Manoa-Palolo Drainage Canal – Wet Weather

Ala Wai Canal – Wet Weather



Ala Wai Boat Harbor – Wet Weather

Figure 13: Photos of Ala Wai Watershed

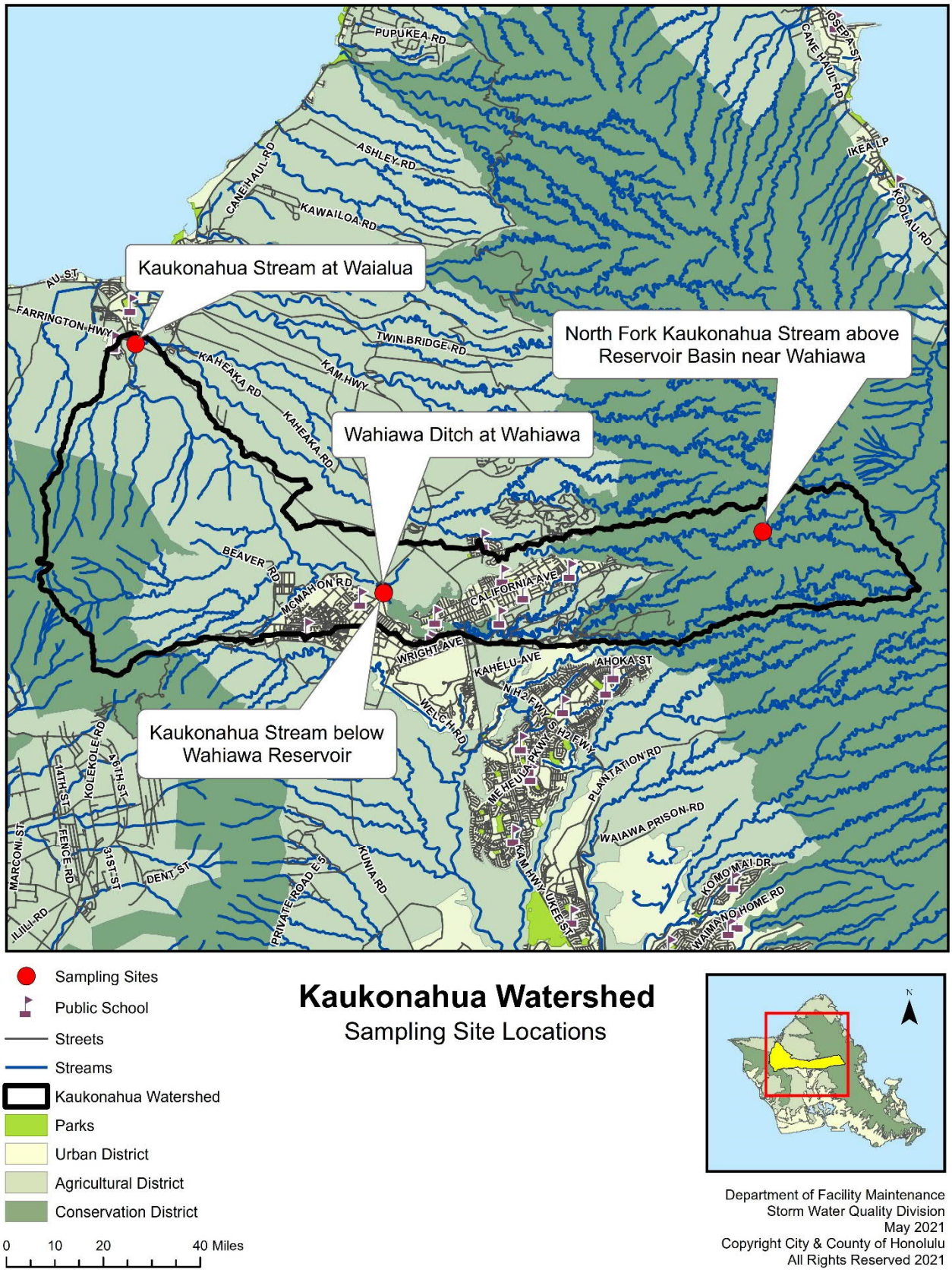
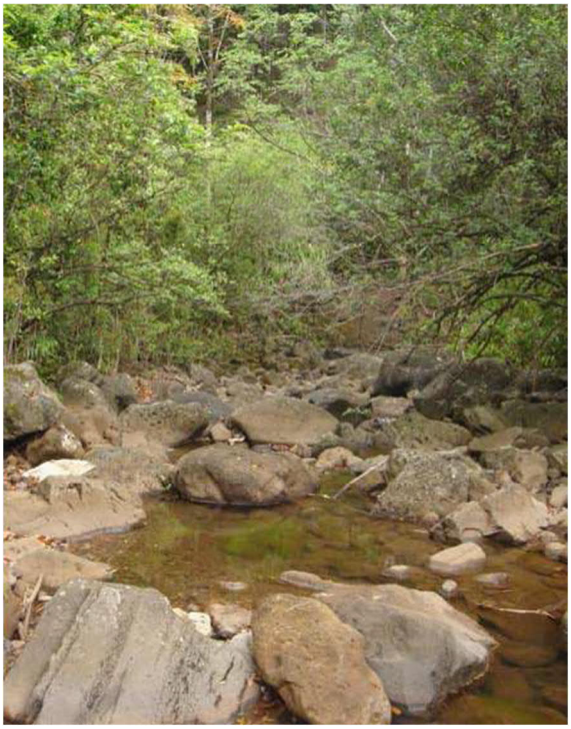


Figure 14: Waialua-Kaiaka Watershed Sampling Site Locations

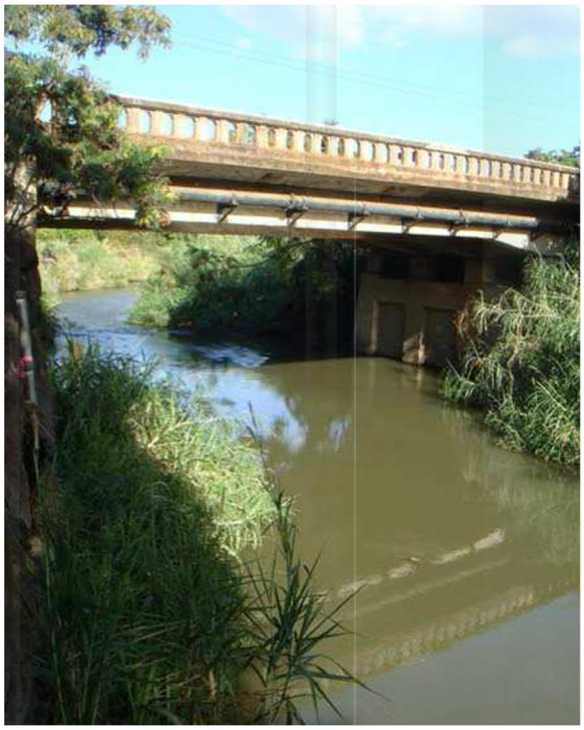
Wahiawa Reservoir Dam Outlet



Upper Waialua-Kaiaka Watershed

Wahiawa Ditch Outlet to Kaukonahua Stream

Upper Kaukonahua Stream



Lower Kaukonahua Stream at Farrington Hwy.

Figure 15: Photos of Waialua-Kaiaka Watershed

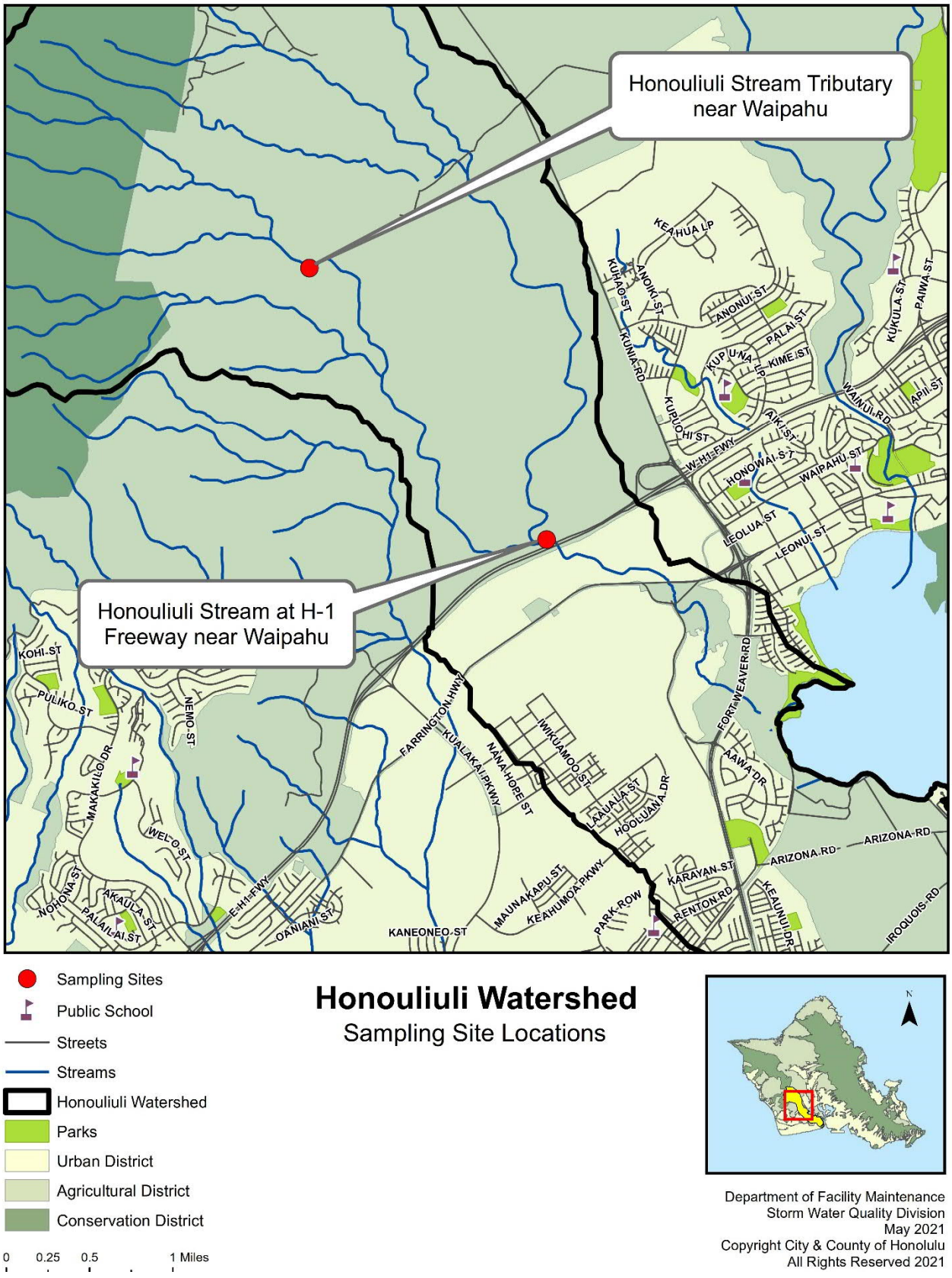


Figure 16: Honouliuli Watershed Sampling Site Locations

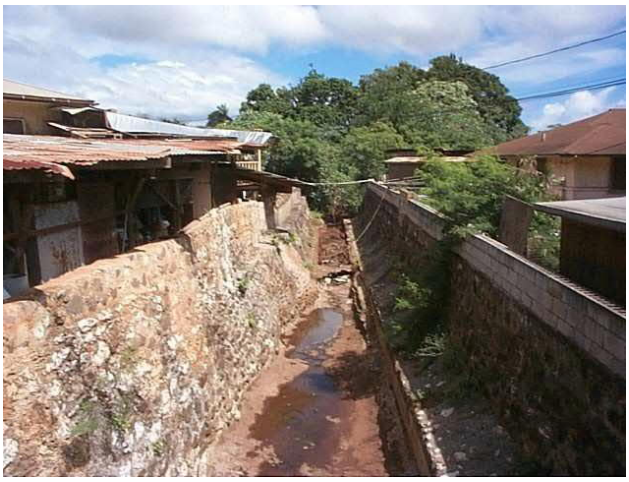
Upper Honouliuli Stream

Watershed (Fallow Agricultural Lands)

Honouliuli Stream at Farrington Hwy (Upstream)

Honouliuli Stream at Farrington Hwy (Downstream)

Lower Honouliuli Stream (Channelized Portion)



Lower Honouliuli Stream (Channelized Portion)

Figure 17: Photos of Honouliuli Watershed

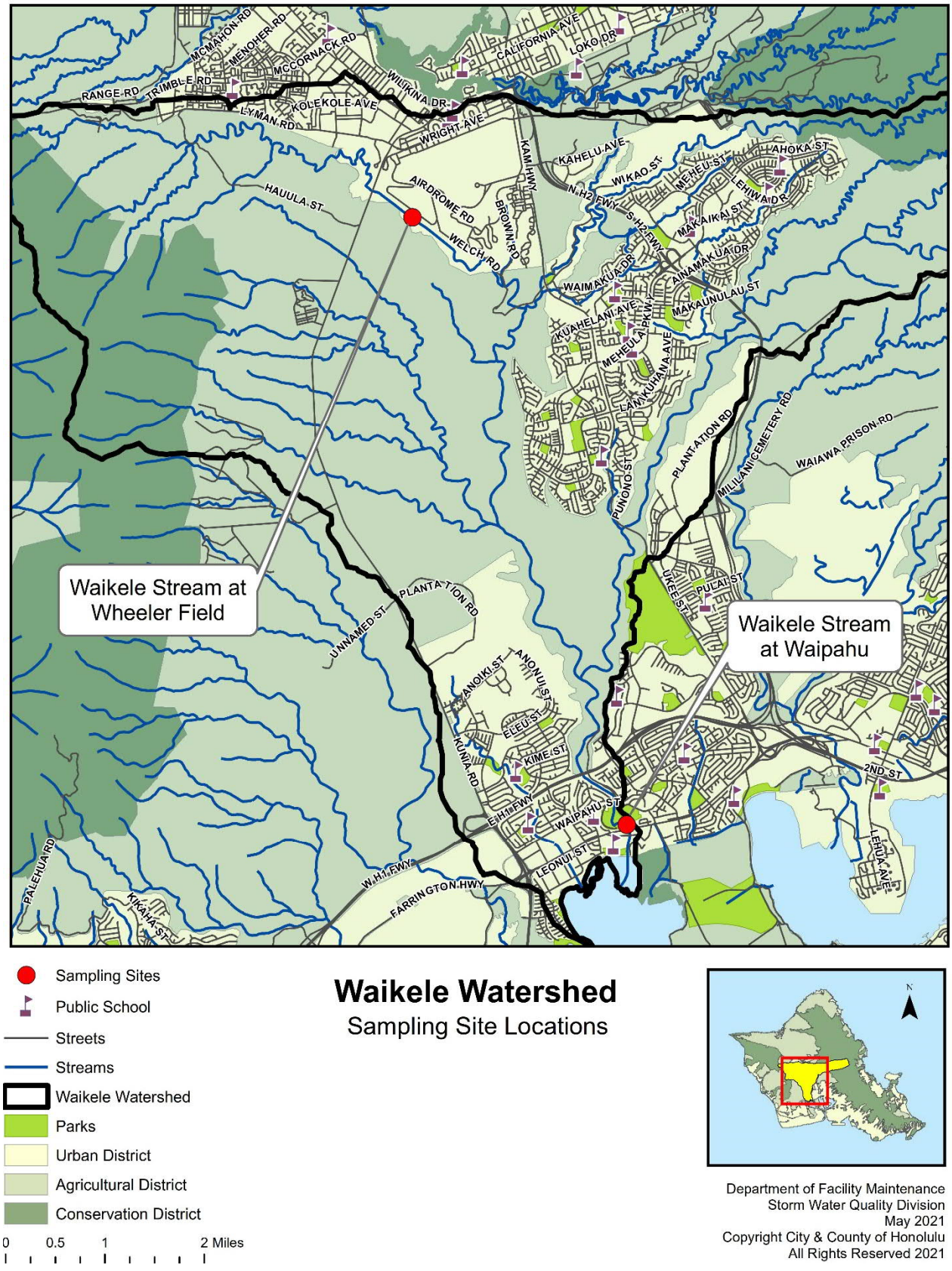


Figure 18: Waikele Watershed Sampling Site Locations

C. DRY WEATHER OUTFALL SCREENING

Currently, the DFM-SWQ is in the process of revising both its Response Plan for Investigations and Illegal Discharges (Response Plan) and Field Screening Plan. The Permit requires that both plans be updated one (1) year from the Permit effective date and be submitted with the City's Storm Water Management Program Plan (SWMPP). Both revised plans were submitted on September 1, 2021. The Response Plan describes the process by which the City responds to complaints and/or reports of illicit discharges and how the City identifies illegal connections to its MS4. The Field Screening Plan focuses on methods for prioritizing and identifying screening sites for dry weather flows and establishes the protocols to mitigate the illegal discharge. Both plans work in concert to provide a comprehensive process for detecting and eliminating illicit discharges. This information will ultimately be used towards determining the effectiveness of the City's SWMP.

The Field Screening Plan includes prioritizations for observing both major and minor outfalls to screen for illicit discharges and procedures for assessing dry weather flows and erosion observed at its outfalls. Field screening in prioritized areas involves an intensive search for illegal discharges by reviewing the existing inventory and map of the storm water system in the area, conducting inspections of drain outfalls in the designated area during dry weather conditions, conducting walkthrough inspections of industrial and commercial facilities to review existing practices, encouraging businesses to use BMPs, and following up with enforcement actions when necessary. Outfalls are checked as a part of this survey and as part of follow-up investigations. Outfall inspections include a visual inspection of the physical and environmental conditions at each site. The City has established enforcement procedures for violations or deficiencies uncovered during the field screening process which is described in the City's 2021 SWMPP.

At least one (1) field screening survey has been conducted annually since 1995.

Criteria for the priority area inspections include structures located in TMDL watersheds, highly urbanized, high density areas (e.g., Waikiki and Downtown-Chinatown), findings from previous and current inspection and maintenance activities, locations of industrial and commercial facilities, documented storm water violations, and areas of homeless encampments. If a dry weather flow is observed, the flow is inspected for visual characteristics such as color, sheen, odor, and turbidity and documented with inspection forms and photographs. If such characteristics are detected, efforts will be made to trace the flow upstream to determine the location and source of the discharge and initiate appropriate enforcement actions to stop the discharge.

D. WATERSHED WATER QUALITY MANAGEMENT PROGRAM

The objective of the City's Watershed Water Quality Management Program is to prioritize and evaluate various watersheds island-wide and identify specific non-point source pollution issues within each of the targeted watersheds. The management program focuses on major land uses including urban, agriculture, conservation, and private land owners to quantify the amount of pollutants that may be contributing to the degradation of the receiving water. The long-term goal is to recommend, prioritize, educate, and implement feasible and cost-effective management measures to improve water quality. Watersheds are selected using a risk-based priority system that accounts for factors such as magnitude of pollutant load, type of impairment(s) identified in the State's 303(d) list of impaired water bodies, exposure of City-regulated facilities and MS4, and potential for water quality improvements. Once identified, the City will evaluate possible funding and potential partnership opportunities as part of a watershed assessment project.

By collecting water quality data at select points within these watersheds that may either be characterized by a specific land use and/or drainage area, the City will be able to better determine the source of the pollutants and monitor the short and long-term impacts on the surrounding stream environment, as well as track the City's progress towards meeting the TMDL requirements. Findings are planned to target resources toward reducing those particular pollutants through on-going activities, programs, or procedures that exist within the capabilities of the City. Additionally, the City is committed to working with other stakeholders and agencies in identifying BMPs or activities that could be implemented within their organizations to improve water quality as part of an integrated planning approach.

The City's watershed planning process has been following an incremental phasing approach to establish a long-term watershed monitoring strategy. The program includes the following key elements as shown in the flow chart diagram on the following page (**Figure 19**). Each phase of the plan is outlined in the sections below.

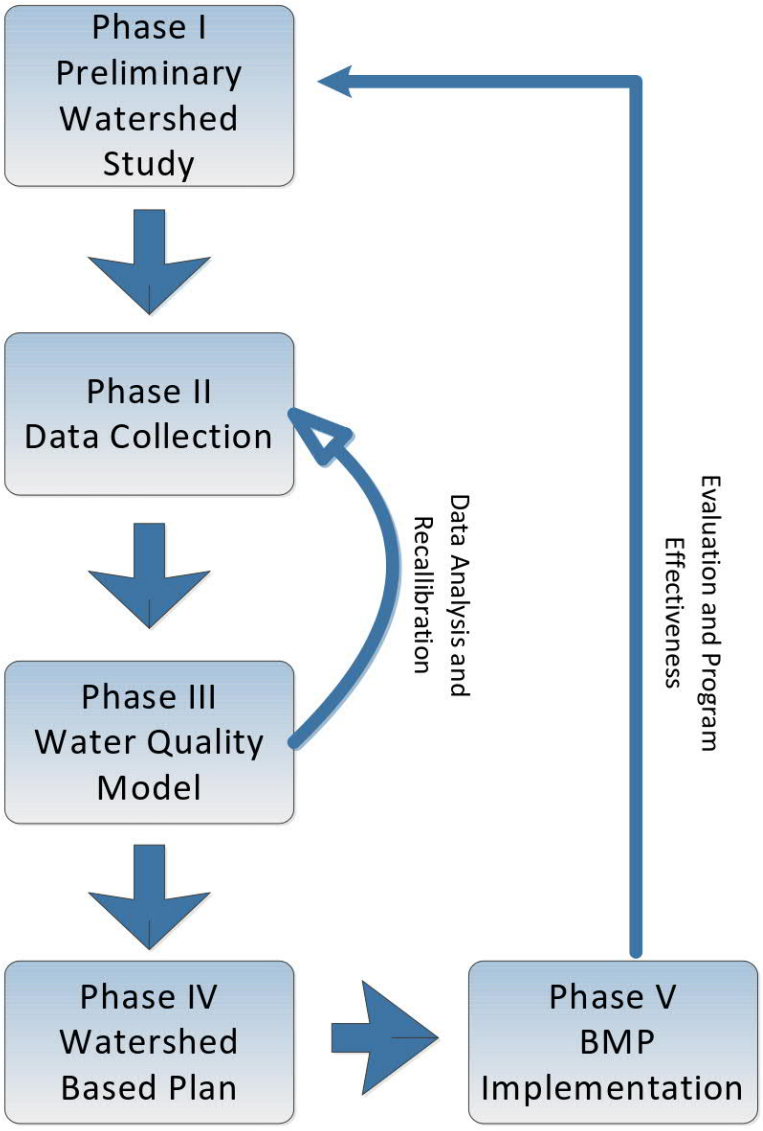


Figure 19: Watershed Management Program Flow Chart Process

1) Phase I: Preliminary Watershed (Desktop Analysis) Studies

DFM-SWQ believes that involving and collaborating with other stakeholders (e.g. large land owners, land management agencies) is necessary to attain lasting water quality improvements in the various impaired watersheds throughout the island. As such, DFM-SWQ is conducting a series of preliminary watershed studies as part of Phase I of the watershed management program. The goals of these studies are as follows:

- Identify potential sources of the pollutants and determine how it may be impacting water quality in receiving waters;
- Identify major stakeholders/landowners within the particular study area;

- Recommend mitigative measures or BMPs to improve water quality; and
- Obtain possible funding/partnership opportunities focusing on water quality.

a) Islandwide Watershed Modeling Study (PLOAD)

In FY20, DFM-SWQ completed an islandwide watershed modeling with the purpose of estimating and comparing pollutant loads across all watersheds on the island of Oahu to assist with planning, compliance, and future BMP implementation. A low complexity model, EPA-PLOAD (Pollutant Loading Estimator), was used for this purpose. The model input included the use of many publicly available GIS data layers which were modified for modeling purposes. The island of Oahu was ultimately divided into 6,419 sub-basins with average drainage areas of 60 acres to allow for sufficient discretization to identify pollution sources, but also balancing model run times and output data manageability. The model output included estimates of pollutant load by watershed, area, and land use. Heat maps were prepared to illustrate the distribution of pollutants across all 6,419 sub-basins on the island.

The PLOAD model was used to simulate BMP implementation and inform decisions regarding potential BMP implementation. Three (3) hypothetical BMP scenarios were modeled for the island of Oahu: (1) quantification of pollutant removal based on the City's inventory of existing BMPs, (2) retrofit of 20% of drain inlets with media filters, and (3) treatment of all rooftop runoff islandwide with an infiltration BMP. Of the three (3) hypothetical scenarios, the rooftop runoff scenario achieved the greatest pollutant reductions. While this option would be difficult to implement, it demonstrates the relative effect of treating impervious surface runoff with infiltration techniques which can inform other decisions regarding BMP implementation.

A report summarizing the islandwide modeling effort, "Oahu Water Quality Modeling Analysis", was published in September 2019.

b) Palolo Stream Focused Watershed Monitoring Approach

DFM-SWQ is proposing to proceed with a focused watershed monitoring approach and selected Palolo Stream Watershed as its chosen location in FY24. For more information on the focused monitoring, see Section II.F.

c) Islandwide GIS Based Watershed Assessment Tool

The City is developing an island-wide GIS-based Watershed Assessment Tool to provide an initial prioritization of Oahu's watershed health from a stormwater perspective. The results will serve as a starting point for further analysis in identifying locations for future programs and projects.

2) Phase II: Data Collection (USGS and Other Automatic Sampling)

During this phase, the DFM-SWQ looks towards establishing a process for determining the overall health of a particular water body by collecting continuous stream measurements for flow and sediment that would be able to quantify and identify the major impacts on water quality

which could be used towards measuring long term trends as described previously in Section II.B.4. The DFM-SWQ focused its efforts on stream sampling as a way of obtaining long term water quality data that would be needed towards establishing a baseline data set while also quantifying pollutant loads during various stages of storm events from targeted subwatersheds characterized by different land uses.

The City also collects water quality samples from its MS4 system during storm events to determine EMCs of targeted land uses.

These water quality data have been used in calibrating watershed models developed under the City's watershed management program as described in Phase III below. The data also allows the DFM-SWQ to better understand the major impacts on water quality and evaluate long term trends of improvement or degradation.

a) Ala Wai and Other TMDL Watersheds

DFM-SWQ will continue monitoring in the Ala Wai Canal Watershed (i.e. Makiki, Manoa and Palolo Streams) and other TMDL Watersheds (i.e. Kaneohe, Waimanalo and Kawa Streams) with the assistance of USGS to collect grab and automatic samples for suspended sediment (TSS, Turbidity and Suspended Sediment) and nutrient (Total Nitrogen, Ammonia, Nitrate+ Nitrite as Nitrogen, Phosphorus, and Orthophosphate) concentrations (Phase II). The DFM-SWQ anticipates obtaining annualized sediment loads targeting multiple land uses (e.g. agriculture, conservation, residential, commercial, etc.). The current water quality monitoring agreement with USGS is scheduled to conclude at the end of September 30, 2024. Contract negotiations are underway to continue water quality monitoring efforts within the majority of the TMDL watersheds beyond Federal Fiscal Year 2024.

b) Central Oahu (Waikele Stream) Watershed

DFM-SWQ will continue monitoring Waikele Stream with the assistance of USGS to collect grab and automatic samples for suspended sediment (TSS, Turbidity and Suspended Sediment) and nutrient (Total Nitrogen, Ammonia, Nitrate+ Nitrite as Nitrogen, Phosphorus, and Orthophosphate) concentrations (Phase II). The DFM-SWQ anticipates obtaining annualized sediment loads targeting multiple land uses (e.g. agriculture, new residential development, etc.). The current water quality monitoring agreement with USGS was scheduled to conclude at the end of September 30, 2021. However, due to the COVID-19 pandemic and delays in the installation of certain monitoring stations, the USGS has proposed to extend these agreements through September 30, 2026 at no additional cost.

c) Waialua-Kaiaka Watershed

The current water quality monitoring agreement with USGS was expected to conclude at the end of September 30, 2021. However, due to the economic impacts related to the COVID-19 pandemic and anticipated future budget cuts, DFM-SWQ is currently re-evaluating and prioritizing its monitoring approach and agreements with USGS. Future monitoring agreements starting as early as Federal Fiscal Year 2024 and beyond are likely to be streamlined, through long term partnerships with other agencies such as the State Department of Land and Natural Resources who may be able to fund additional

station(s); thereby allowing DFM-SWQ to reduce its overall costs and continue with its monitoring efforts within the Kaukonahua Stream Watershed.

d) Honouliuli Stream-Kaloi Gulch Watershed

DFM-SWQ will continue monitoring Honouliuli Stream with the assistance of USGS to collect grab and automatic samples for suspended sediment (TSS, Turbidity and Suspended Sediment) and nutrient (Total Nitrogen, Ammonia, Nitrate+ Nitrite as Nitrogen, Phosphorus, and Orthophosphate) concentrations (Phase II). The DFM-SWQ anticipates obtaining annualized sediment loads from targeting multiple land uses (e.g. agriculture, conservation, etc.). The current water quality monitoring agreement with USGS was scheduled to conclude at the end of September 30, 2021. However, due to the COVID-19 pandemic and delays in the installation of certain monitoring stations, the USGS has proposed to extend these agreements through September 30, 2026 at no additional cost. See **Figure 16**.

e) Salt Lake Watershed

DFM-SWQ brought in a monitoring contractor to install, operate, and monitor a number of field sampling sites to test for various water quality parameters such as TSS, Ammonia Nitrogen, Nitrate + Nitrite as Nitrogen, Total Phosphorus, and Metals. The sampling program concluded in June 2017. No further sampling is planned in FY24. See **Figure 20**.

f) Kaelepulu Watershed

DFM-SWQ brought in a monitoring contractor to install, operate, and monitor a number of field sampling sites to test for various water quality parameters such as TSS, Ammonia Nitrogen, Nitrate + Nitrite as Nitrogen, Total Phosphorus, and Enterococci. The sampling program concluded in December 2017. No further sampling is planned in FY24. See **Figure 21**.

g) Keehi Lagoon (Kalihi and Moanalua Stream) Watershed

DFM-SWQ assisted the State DOH in establishing and developing a water quality sampling program within the Keehi Lagoon Watershed for future TMDL development. Water quality sampling concluded in FY23. There has been some initial discussion with USGS in establishing a long term monitoring agreement within this area once TMDLs have been established. Those discussions are expected to continue in FY24. See **Figure 22**.

h) Maunalua Bay Watershed

No water quality monitoring is proposed in FY24 within the Maunalua Bay Watershed.

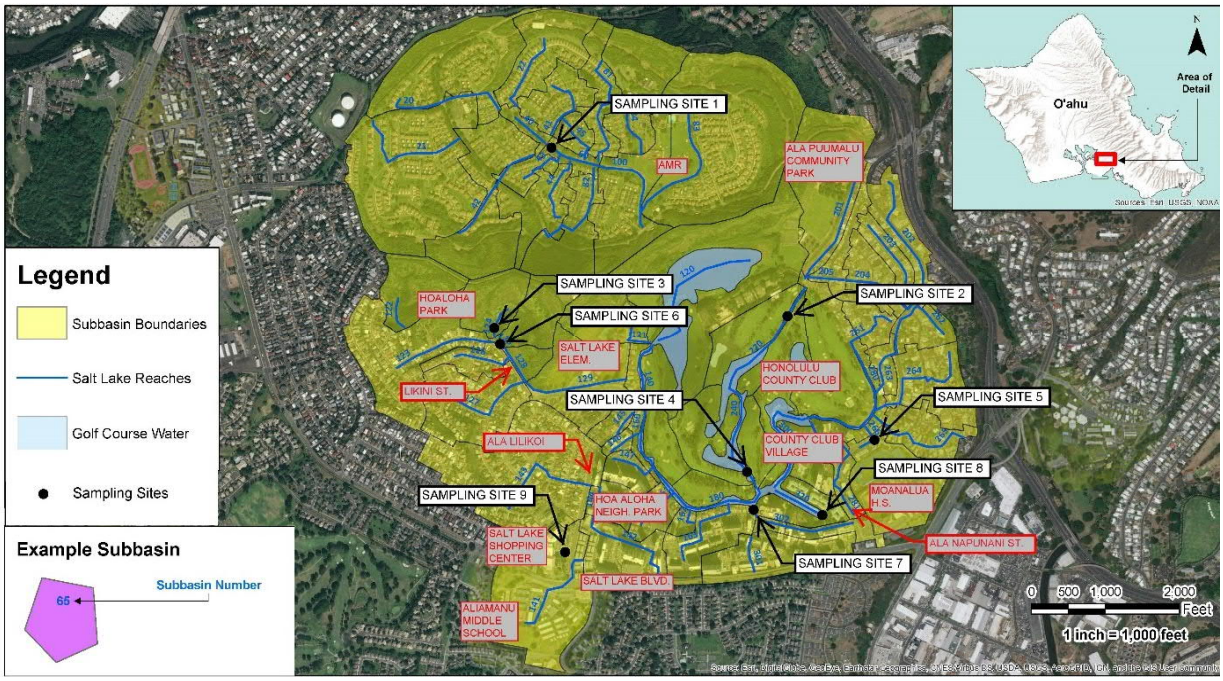


Figure 20: Salt Lake Watershed Study Area

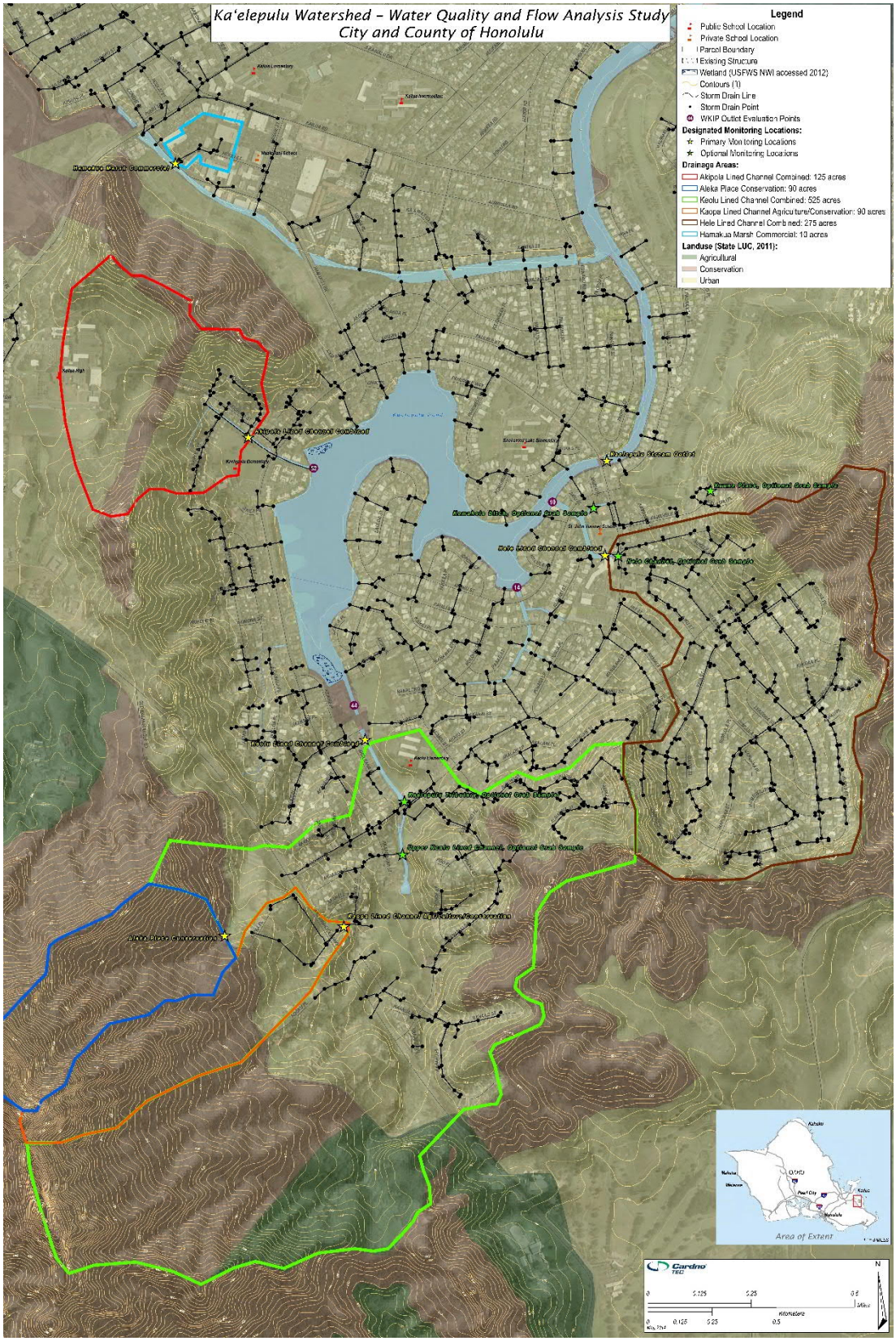


Figure 21: Kaelepulu Watershed Study Area

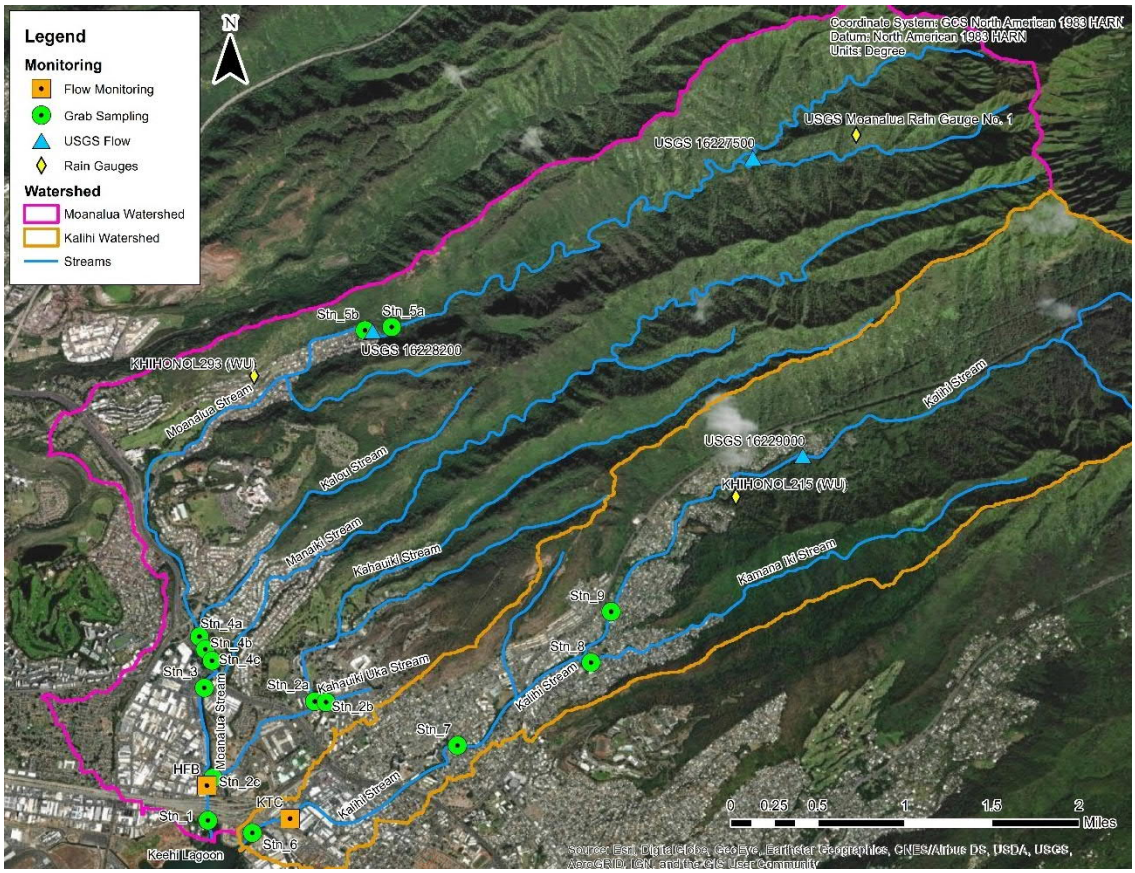


Figure 22: Keehi Lagoon Study Area

3) Phase III: Water Quality Model

In Phase III of the watershed management program, DFM-SWQ developed various water quality models. The primary purposes of the modeling are as follows:

- Assist DFM-SWQ in water quality and BMP planning efforts;
- Evaluate the effects of land use changes within a particular watershed;
- Monitor and track implementation of specific BMPs and its effectiveness; and
- Develop a compliance tool to assist with current and future TMDL regulations.

Through a previous comprehensive model screening process, DFM-SWQ selected the following models: Hydrological Simulation Program – Fortran (HSPF), U.S. EPA's Storm Water Management Model (SWMM), and Pollutant Loading Estimator (PLOAD) to address different aspects of the watershed management program.

a) Islandwide Watershed Modeling Study (XPSWMM)

In FY19, when DFM-SWQ initiated the islandwide watershed modeling study (PLOAD) described in Phase I above, a concurrent modeling effort to further develop selected high

priority watersheds was conducted. Similar to the PLOAD modeling effort, the purpose of the study was to estimate and compare pollutant loads across 20 priority watersheds by using a higher resolution, moderate complexity model for more detailed evaluation and BMP implementation studies. The EPA's Storm Water Management Model (SWMM), in conjunction with additional capabilities of third party enhancement software (XPSWMM) was used for this task. The 20 highest priority watersheds were selected based on three main factors which included data availability, pollution potential, and synergistic activities. Synergistic activities include the evaluation of independent activities that could provide useful data input into the model or those that require special consideration, such as TMDL watersheds. The 20 highest priority watersheds that were modeled using XPSWMM include: Ala Wai, Halawa, Heeia, Honouliuli, Kahaluu, Kalauao, Kalihi, Kaloi, Kaneohe, Kapakahi, Kawa, Kiikii, Makaiwa, Nanakuli, Nuuanu, Salt Lake, Waiawa, Waikele, Wailupe, and Waimalu.

The report summarizing the islandwide modeling effort, "Oahu Water Quality Modeling Analysis", was published in September 2019.

In FY24, the DFM-SWQ plans to expand the XPSWMM modeling to include the next tier of high priority watersheds, pending budget approval.

b) Kaelepulu Watershed

DFM-SWQ in partnership with the State DOH and DOT will be performing a recalibration of the watershed model in order for DOH Clean Water Branch to initiate its efforts with developing a future TMDL for the Kaelepulu Watershed. A Memorandum of Agreement (MOA) was executed with the State DOH in late FY22. It is anticipated that work will begin in FY23 and will be completed by the end of FY23.

4) Phase IV: Watershed Based/BMP Planning Assessment Study

As part of Phase IV of the watershed management program, the DFM-SWQ is planning to develop a watershed based study in accordance with the U.S. EPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (March 2008). The intent is to develop a watershed based plan that meets U.S. EPA requirements, which would eventually allow the City to apply for 319(h) grant funding to implement water quality improvement projects. One key limitation of the 319(h) grant is that the projects must not be a requirement of the MS4 Permit or be included in the City's SWMP. Therefore, any acquired funding would be applied toward management of non-point pollutant sources that are not regulated under the City's NPDES Permit. No watershed based studies are scheduled to be conducted during FY24.

a) BMP Tool

In FY23, DFM-SWQ completed a review of 47 candidate BMP tools to be used for planning of new BMPs across the island. The initial list of candidate tools were screened based primary selection criteria (e.g., pollutant load reduction estimates, basin scale, model complexity, BMP analyzed, cost estimating and optimizing, user base, and GIS linkage) and secondary selection criteria (e.g., graphical user interface, user documentation, and open source code). This evaluation resulted in a short list of 13 BMP tools that were further evaluated based on a weighted ranking scale.

The preliminary recommendation for the highest ranking BMP Tools with lowest cost optimization are: iDST, WMOST, Opti-Tool, SARA BMP Processor/SARA Enhanced BMP Tool, GreenPlanIT, and OSTRICH-SWMM. If lowest cost optimization is excluded from the analysis, the highest ranking BMPs Tools are: CLASIC, SARA BMP Processor, SLAMM/WinSLAMM, and PLOAD.

The final selection of a BMP Tool is pending further detailed evaluation which may include pilot testing each of the highest ranking models, depending on whether or not cost optimization is considered a key objective. This work is not yet scheduled.

b) GIS Trash Assessment Tool

This section is in progress.

5) Phase V: BMP Implementation

The final phase of the watershed management program covers the implementation of BMPs to control pollutants entering the impaired water bodies. BMPs can be costly when accounting for both construction and maintenance costs over the lifetime of the BMP. Therefore, BMPs are typically considered a last resort after all other methods for achieving pollutant load reductions have been explored. However, one advantage of BMPs is that they provide a means of quantifying water quality improvements to help evaluate the effectiveness of a watershed management program. The City uses an adaptive management process whereby BMP implementation and monitoring programs are re-evaluated annually to identify any required changes.

a) Ala Wai Watershed Study

The USACE has been conducting a comprehensive planning study within the Ala Wai Watershed, which includes the Makiki, Manoa, and Palolo sub-watersheds. This work is in support of the multi-objective Ala Wai Watershed Project, with the overarching goal of improving the overall quality of the watershed, while minimizing the risk of flood damage to the public. The objectives of the project are flood risk management, ecosystem restoration, water quality, water supply, recreation, and infrastructure maintenance. The local sponsors for the project are the State Department of Land and Natural Resources (DLNR) Engineering Division and the DFM-SWQ.

In FY17, a calibrated water quality model using the HSPF program was completed. A BMP effectiveness tracking program was developed in FY19. Long term planning efforts for the watershed are being re-evaluated. It is possible that a BMP implementation study will be considered starting in FY24 to help DFM-SWQ in identifying various planning scenarios to determine the effectiveness of the recommended structural and non-structural BMP modifications necessary to demonstrate water quality improvements. However, this decision will be dependent on future budget approvals and availability of staff and resources to initiate and oversee such a study.

b) Central Oahu (Waikele Stream) Watershed Study

The Central Oahu Watershed study consists of nine (9) watersheds that comprise the Central Oahu basin and account for almost a quarter of the island of Oahu. The area

drains in the southerly direction towards one of the three main lochs of the Pearl Harbor Estuary.

This study originally started as a phased project in late 2003 under an existing agreement between the Honolulu Board of Water Supply and USACE. Phase I of the study, completed in May 2007, provided a broad overview of water-related information that could be used to identify resource problems and develop potential solutions in improving watershed health for the entire Central Oahu area that drains into the Pearl Harbor estuary, as well as lands of the Ewa District to the boundary of the Waianae District. As part of the Phase I study, a number of recommendations were presented that could assist the City with meeting these goals. The DFM-SWQ moved forward on the Phase III portion of their partnership study with the USACE to identify, recommend, and develop a calibrated model for the Waikele Stream Watershed. The study started in December 2007 and concluded towards the latter part of FY10.

In addition to the USACE study, the DFM-SWQ also partnered with the USGS on a multi-year study of the Waikele Stream Watershed beginning in FY08. The purpose of the project was to determine the effects of upstream land uses on annual stream suspended sediment loads. The study was conducted over a period of 5.5 years in which the USGS monitored sediment loads from tributaries characterized primarily as conservation, urban, agricultural, or military source areas. The study concluded in July 2012, in which a report summarizing USGS's findings were provided to the DFM-SWQ. The results were used to evaluate source allocations in TMDL analyses being developed by the DOH and EPA for the Pearl Harbor Basin. Sediment concentrations and continuous flow readings were also incorporated into the Phase III Waikele Stream Watershed water quality model.

During FY12, the DFM-SWQ completed a geomorphic assessment of the major tributaries in the watershed to better define sediment sources and existing stream conditions. An assessment report was prepared based on the field reconnaissance work. The DFM-SWQ completed post-processing of the data by incorporating the findings into the Waikele Stream watershed model in FY19.

c) Waialua-Kaiaka Watershed Study

The Waialua-Kaiaka watershed has three (3) major perennial stream systems – Kiikii Stream (includes Poamoho Stream and the North and South Forks of Kaukonahua Stream), Paukauila Stream (includes Opaeula Stream and Helemano Stream), and Anahulu Stream (includes Kawaiki Stream, Kawainui Stream, and Kawailoa Stream). The purpose of the Waialua-Kaiaka Watershed study was to provide guidance on how to improve surface water quality of Waialua Bay, Kaiaka Bay, and their tributaries so that they meet their respective water quality standards.

The Kaiaka Watersheds are comprised of approximately 51,454 acres of land situated between the ridgelines of the Waianae and Koolau mountain ranges and extending toward the North Shore, where the streams converge and flow into Kaiaka Bay, located in the beach town of Waialua. Together, the six Kaiaka Bay Watersheds make up approximately 13.5% of Oahu's total land area.

A watershed based plan was prepared by the City for the Kaiaka Bay Watershed in partnership with the State DOH and USEPA. The plan met the U.S. EPA's criteria for developing a watershed plan with the goal of getting all major stakeholders involved in the process. The joint funded watershed planning study (Phase IV) was cost-shared through DOH using available Federal USEPA Clean Water Act (CWA) § 319(h) nonpoint source grant-funds, while the remaining match was funded by the DFM-SWQ. The study was completed in April 2018 and is currently available on the DOH's website. Copies of the report can be downloaded at http://health.hawaii.gov/cwb/clean-water-branch-home-page/polluted-runoff-control-program/watershed-plans/. The DOH also completed its review and accepted the plan, in which future grant proposals for implementation are eligible for the EPA funding via the State's Request for Proposals (RFP) process.

d) Honouliuli Stream Watershed Study

Over the past several years, City facilities, namely the West Loch and Ewa Villages Golf Courses, have been damaged by flooding and heavy sedimentation loads due to large rain events. During a series of large storms that occurred in the months of February 2004 and 2006, December 2008, and January 2011, both courses faced significant damages. These damages resulted in the closure of parts of or the entire golf course for an extended period of time. According to City golf course personnel, these occurrences are becoming increasingly more frequent, and there is concern that this situation may become the norm, rather than the exception. With the increase in urban development and a large portion of the watershed devoted to agricultural and conservation lands, the DFM-SWQ felt that further studies were warranted to investigate the potential impacts that Honouliuli Stream may be having on the City's MS4 and its facilities in regard to sedimentation and water quality.

e) Salt Lake Watershed Study

In December 2003, the ENV (now DFM-SWQ) partnered with the USACE to conduct a sediment runoff analysis of the Salt Lake Watershed (Phase IV). The study was completed in August 2006. The objectives of the study were to (1) determine an estimate of annual sediment yield into Salt Lake as a result of rainfall-runoff from contributing drainage areas, and (2) provide an estimate of sediment yield into Salt Lake since 1970 for historic storm events equal or exceeding the 10-year, 1-hour rainfall intensity. The intent of this study was to provide the City with estimated quantities of sediment runoff into Salt Lake by contributing areas and provide the necessary documentation to obtain possible future assistance funding for projects that may improve water quality and environmental conditions within Salt Lake. Meanwhile, the DFM-SWQ proceeded with the design of various structural BMPs (Phase V) such as storm drain filters, inlet screens, hydrodynamic separators, and debris basins based on the prioritized drainage areas identified in the sediment study as being major contributors of the accumulated sediment in Salt Lake. Installation of storm drain filters were completed in previous years, while the construction of the hydrodynamic separator and inlet screening devices were planned for completion in FY22, but were not constructed due to supply issues and scheduling delays associated with COVID-19. While the project is on hold indefinitely, the City will consider re-soliciting bid proposals in FY24. Construction of the two (2) Salt Lake

Debris Basins were completed and accepted towards the end of 2022. Also in FY22, the DFM-SWQ completed the development of a calibrated water quality watershed model (Phase III) using the HSPF program and BMP alternatives analysis.

f) Kaelepulu Pond Watershed Study

The DFM-SWQ completed a water quality watershed planning study (Phase IV) for Kaelepulu Pond in FY19. The intent of the study was to identify the potential sources of pollutants within the watershed and recommend various BMP improvements that could be feasibly implemented to improve the overall health of Kaelepulu Pond. As part of the Kaelepulu watershed analysis study, the DFM-SWQ developed a calibrated water quality model (Phase III) using the HSPF program to identify and quantify pollutant sources, as well as prepare various simulations for different BMP scenarios that could be used in tracking specific changes within the watershed. During FY18-FY21, DFM-SWQ installed various water quality improvement projects (catch basin inlet filters and automatic retractable screens) and implemented streambank restoration projects along Kamahele Ditch and Hele Channel. The DFM-SWQ is also working closely with DOH who is in the process of developing a TMDL for Kaelepulu Pond. A re-calibrated watershed model is planned to be completed in FY23 and turned over to DOH for further TMDL analysis.

A summary of Phase I through Phase V activities and progress is shown in **Figure 23**. See also **Table 5** for a list of the watershed management studies.

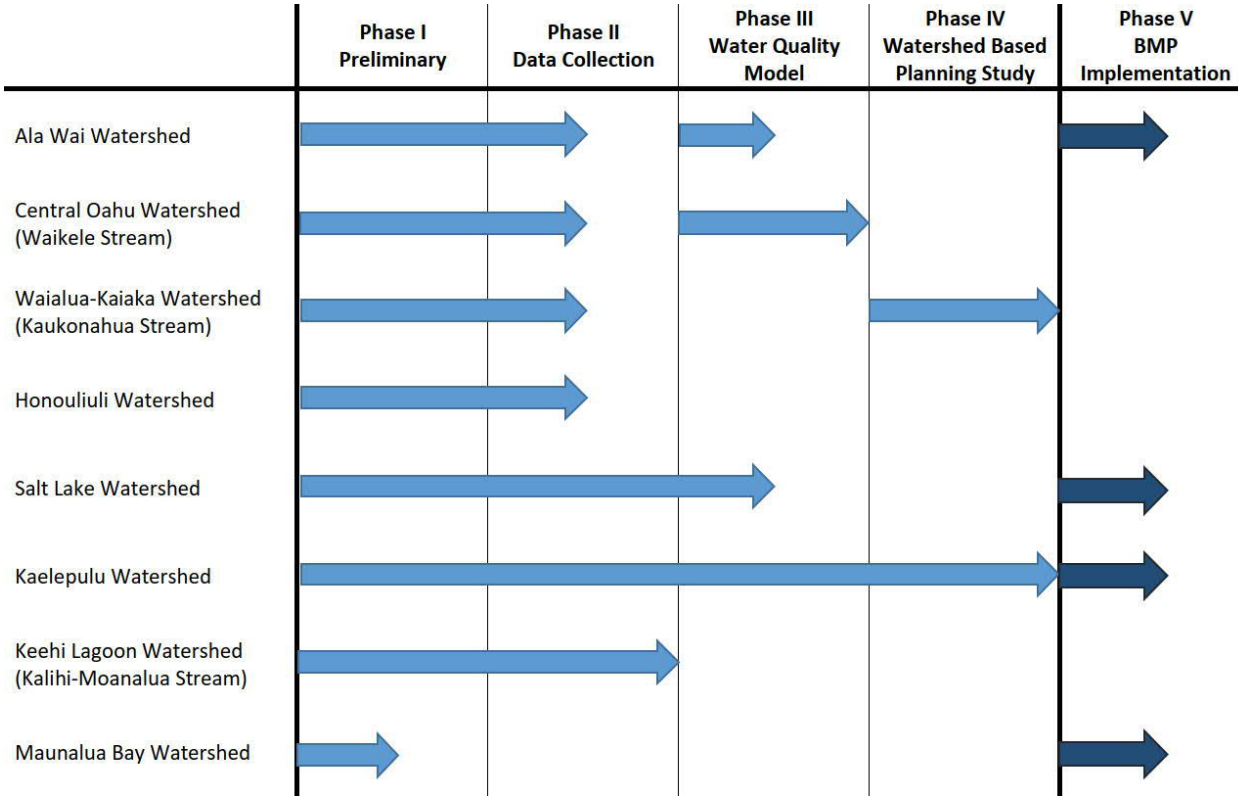


Figure 23: Watershed Management Program Overview

Table 5: Watershed Management Studies Priority Locations

Watershed	TMDL / 303(d) Listed	Other City MS4 Impacts	Partners	Pollutants of Concern	Status
Ala Wai (including Palolo Stream Watershed)	Yes / Yes	City outfalls and stream channels, Ala Wai Golf Course	U.S. Army Corps of Engineers, U.S. Geological Survey, State Department of Land and Natural Resources, The Nature Conservancy, University of Hawaii	Sediment, Nutrients, Termiticides	Phase I completed. Phase II, III and V ongoing.
Central Oahu (Waikele Stream)	Yes / Yes	City outfalls and stream channels	U.S. Army Corps of Engineers, U.S. Geological Survey, Honolulu Board of Water Supply State DOH	Sediment, Nutrients	Phase I and III completed. Phase II ongoing.
Waialua -Kaiaka (Kaukonahua Stream)	Yes (Upper Kaukonahua Stream) / Yes	City outfalls and stream channels, Wahiawa Wastewater Treatment Plant	U.S. Geological Survey, State DOH	Sediment, Nutrients	Phase I and IV completed. Phase II ongoing.
Honouliuli	No / Yes	City outfalls and stream channels, West Loch Golf Course	U.S. Geological Survey	Sediment, Nutrients	Phase I completed. Phase II ongoing.
Salt Lake	No / Yes	City outfalls into privately owned waterbody	U.S. Army Corps of Engineers	Sediment, Nutrients	Phase I and II completed. Phase III and V ongoing.
Kaelepulu	No / Yes	City outfalls into privately owned waterbody	State DOH	Sediment, Nutrients	Phase I, II, III, and IV completed. Phase V ongoing.
Keehi Lagoon (Kalihi and Moanalua Stream)	No / Yes	City outfalls and stream channels	State DOH	Sediment, Nutrients, Bacteria	Phase I and II completed. Follow-on Work by DOH.
Maunalua Bay Watershed	No / Yes	City outfalls and stream channels	Malama Maunalua	Sediment, Nutrients	Phase I and V ongoing.

E. BIOASSESSMENT MONITORING PROGRAM

The DFM-SWQ, in partnership with UH, has conducted numerous bioassessments and reconnaissance surveys for select streams and watersheds across the island over many years. These studies can provide critical information on the overall health of a watershed and identify the feasibility of potential stream restoration projects. The data can also be used to calculate an overall mean value of biotic integrity and habitat quality for the stream and its tributaries. In addition, the data can be used to compare stream quality/condition between sites along the stream continuum in order to evaluate the effects of varying stages of urban influences on the stream.

In the past, the Hawaii Stream Bioassessment Protocol (HSBP) has been implemented with the following primary objectives:

- Develop a species list of fish, macroinvertebrates, and/or algae inhabiting the stream;
- Evaluate and compare the condition and species composition of the riparian area adjacent to the study stream reach;
- Evaluate and compare stream habitat quality in the study reach;
- Evaluate and compare the "biotic integrity" of the stream environment to Hawaiian "reference stream" standards; and
- Evaluate and compare the relative level of primary and secondary productivity (only if algae/invertebrate sampling is included).

Due to permitting issues, the DFM-SWQ has effectively put all future plans for its bioassessment studies on hold and is re-assessing its long-term strategy. However, in FY24, the DFM-SWQ is planning to move forward and hold discussions with the DOH and the research community (i.e. UH, State DLNR) to identify potential opportunities to develop a bioassessment monitoring plan for the island, and determine how it can be applied towards measuring program effectiveness.

F. PALOLO STREAM FOCUSED WATERSHED PLAN

In FY21, the DFM-SWQ launched a "Focused Watershed Plan" (FWP). The intent of the FWP is to re-direct City resources and programs into restoring a single impaired watershed rather than distributing efforts across broad regions of the island. The Plan will specifically seek to 1) identify restoration practices and stormwater treatment BMPs that can be feasibly implemented in the selected watershed; and 2) measure quantitatively the impact of the BMPs on stream water quality.

After a review of recent studies, the DFM-SWQ selected the Palolo Stream watershed for the FWP in FY21. This decision was based on the findings of the baseline trash assessment, an island-wide modeling study, and storm EMC data, all of which suggested that the Palolo watershed is significantly higher in pollutants than other impaired watersheds on Oahu.

The Palolo watershed is actually a sub-watershed of the larger Ala Wai Canal drainage basin (see **Figure 24)**. The basin encompasses three major stream systems: Makiki Stream, Manoa Stream, and Palolo Stream. The Palolo Stream watershed is approximately 2,639 acres, of which 59% is

conservation land, 37% is urban land, and 4% is agricultural. The conservation land is concentrated in the upper valley from the top of the Koolau Mountain peaks to approximately mid-watershed. The two major tributaries of Palolo Stream, Pukele Stream and Waiomao Stream, drain this upper conservation area. The urbanized MS4 portion of the watershed begins at the base of the conservation land near where the tributaries converge into Palolo Stream proper. From here, the rest of the watershed is highly urbanized, primarily single family residential houses in very close proximity to each other. Many of the homes are located immediately adjacent to the stream. Almost all of the stream is channelized (approximately 88%) in the developed portion of the watershed. Other urban land use includes schools such as Palolo Elementary School, Kula Kaiapuni O Anuenue K-12 School, Aliiolani Elementary School, Saint Louis High School, and Chaminade University, along with churches, parks, and a commercial district in the lower valley near Kaimuki. Agricultural land is a minor portion of the watershed and primarily consists of residential homes with small areas of land in production along the private Lai Road near the base of the upper conservation area. Rainfall varies significantly throughout the Palolo Stream watershed. The average annual rainfall in the watershed ranges from approximately 30 inches at the very bottom of the watershed to over 100 inches at the high elevation peaks. The overall average annual rainfall is 47.3 inches.

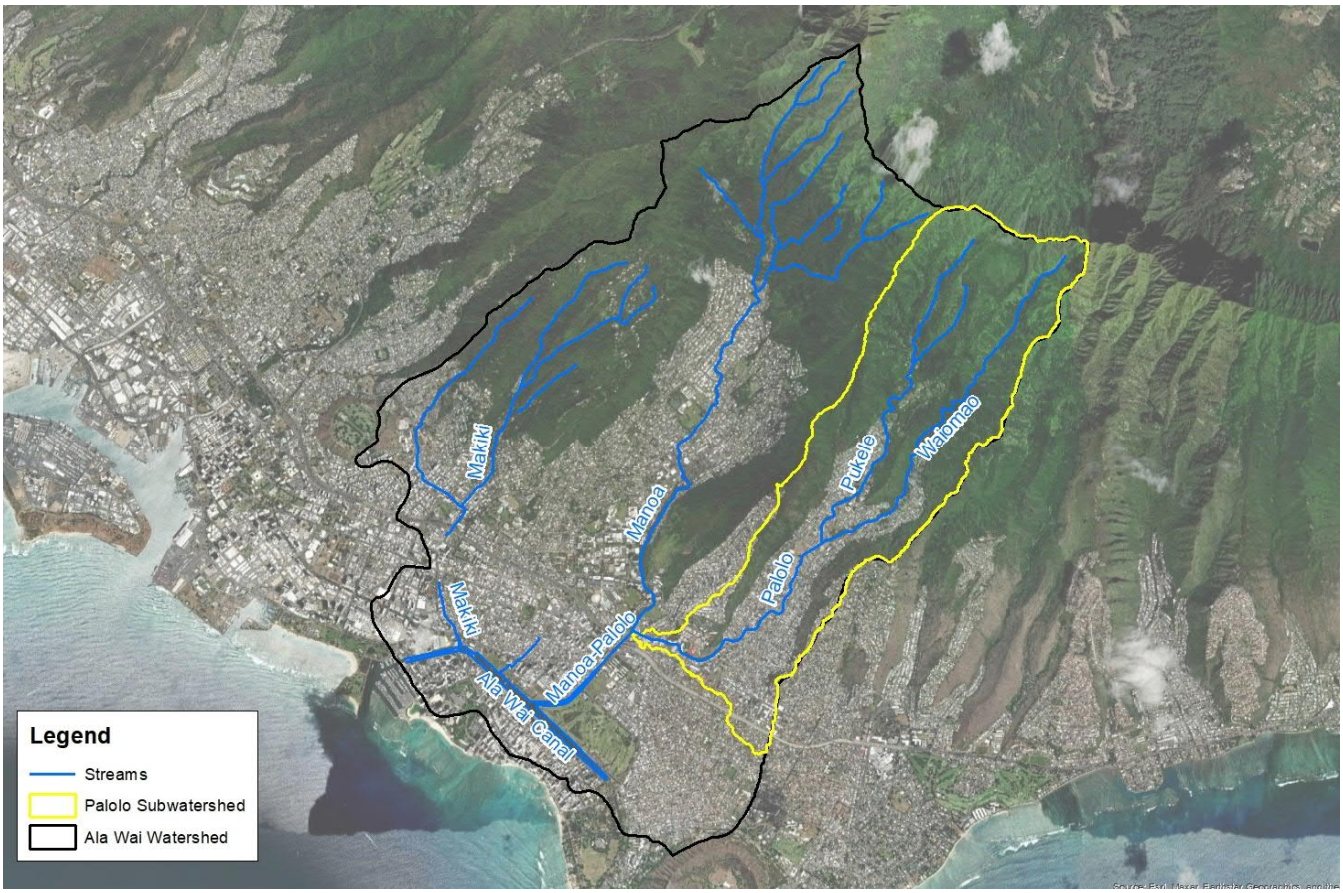


Figure 24: Overview of Palolo Stream Watershed

In September 2020, DFM-SWQ began initial development of the FWP for the Palolo Stream watershed. This included identifying which programs and activities should be involved and developing a strategy for water quality monitoring. In March 2021, DFM-SWQ met with the DOH to present the initial elements of the FWP and discuss potential issues and opportunities.

In FY23, DFM-SWQ hosted a design charrette with other stakeholders in the watershed. The purpose of the charrette was to outline the objectives and strategies of the FWP, seek input, and refine the monitoring approach. Currently, ongoing City activities related to the FWP include the following: gathering data, identifying pollutant sources, performing field reconnaissance of future water quality monitoring sites, finalizing the monitoring methods, obtaining rights-of-entry for private or state land owners, developing monitoring site designs, and communicating with other departments and organizations to ensure a well-coordinated approach.

In FY24, baseline water quality monitoring is expected to begin in the Palolo Stream watershed, provided rights-of-entry (ROE) agreements are obtained for access to private and State land. The goal of the baseline monitoring is to characterize the water quality of Palolo Stream and its tributaries (Pukele Stream and Waiomao Stream) prior to BMP implementation. Baseline monitoring is expected to continue at least through the end of the City's current Permit period which expires on August 31, 2025. Further monitoring during the BMP implementation phase is likely to occur in the following Permit cycle (FY26 – FY30) to determine if any water quality benefits have occurred. The implementation schedule is currently unknown. Post-implementation monitoring may be an option if funding allows and would help identify changes in water quality relative to the baseline. The full duration and timing of the monitoring from FY24 onwards has not yet been determined.

Currently, the monitoring strategy for FY24 includes the collection of both storm samples and baseflow samples throughout the Palolo Stream watershed, from the upper tributaries near the conservation area to the lower confluence with Manoa Stream in the high-density urban areas. The storm samples will be collected at fixed monitoring sites equipped with automated samplers for the collection of storm EMC flow-weighted composite samples, similar to the EOP sampling (see Section II.B.3). Storm samples will be collected as weather permits in both the dry and wet seasons. A variety of rainfall-runoff conditions will be targeted with the goal of obtaining a reasonable approximation of the typical distribution of storm sizes (small, medium, and large) and types (e.g. rainfall intensity, runoff volumes, antecedent dry period, etc.) that are characteristic of Palolo Valley. A sufficient number of storm EMC samples will be collected to allow a meaningful analysis of the data.

To date, two (2) fixed stream stations for the collection of storm EMCs have been identified as part of the FWP. The first is located in the middle of the watershed at the Kalua Road bridge crossing adjacent to the City's maintenance driveway. The other is located in the lower watershed near Saint Louis School / Chaminade University of Honolulu. While these two sites are expected to be constructed and operational in FY24, permits for both sites and a ROE for the Saint Louis School site are still pending. The latter site also needs to be field verified, hence the current location is approximate. See **Figure 25** (Kalua Road) and **Figure 26** (Saint Louis School) for the location of the two fixed stormwater monitoring stations. Additional information on the sites is available in **Table 6**.

The monitoring equipment for the FY24 stormwater monitoring stations will be similar to the equipment used for the EOP monitoring, that is, an automated sampler, a data logger, a rain gauge, and a flow sensor (see Section II.B.3 for details). Both of the FY24 stormwater monitoring stations will include this equipment, although a rain gauge may not be needed at both stations due to their close proximity. A notable addition for the Palolo monitoring will be a turbidity sensor (Observator Analite NEP-5000 Turbidity Sensor) for continuous *in-situ* measurement of turbidity in the stream. A turbidity sensor may potentially be installed at one of the two FY24 monitoring sites. The water quality parameters to be monitored are the same as those for the EOP sampling: TSS, turbidity, TKN, TN, Nitrate + Nitrite as Nitrogen (NO_3+NO_2 as N), Ammonia Nitrogen as N (NH_3-N), Organic Nitrogen, TP, and total metals (lead, copper, and zinc).

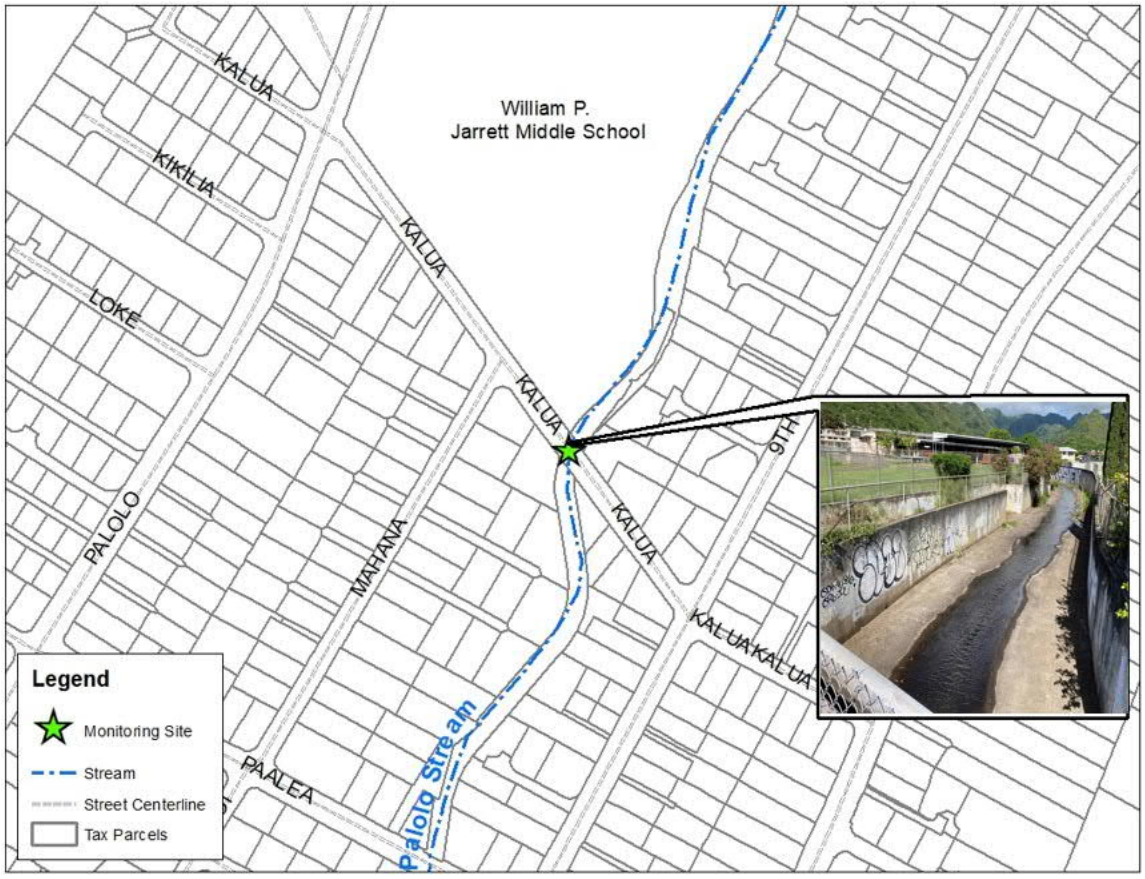


Figure 25: FY24 Palolo Stream Stormwater Monitoring Station at Kalua Road

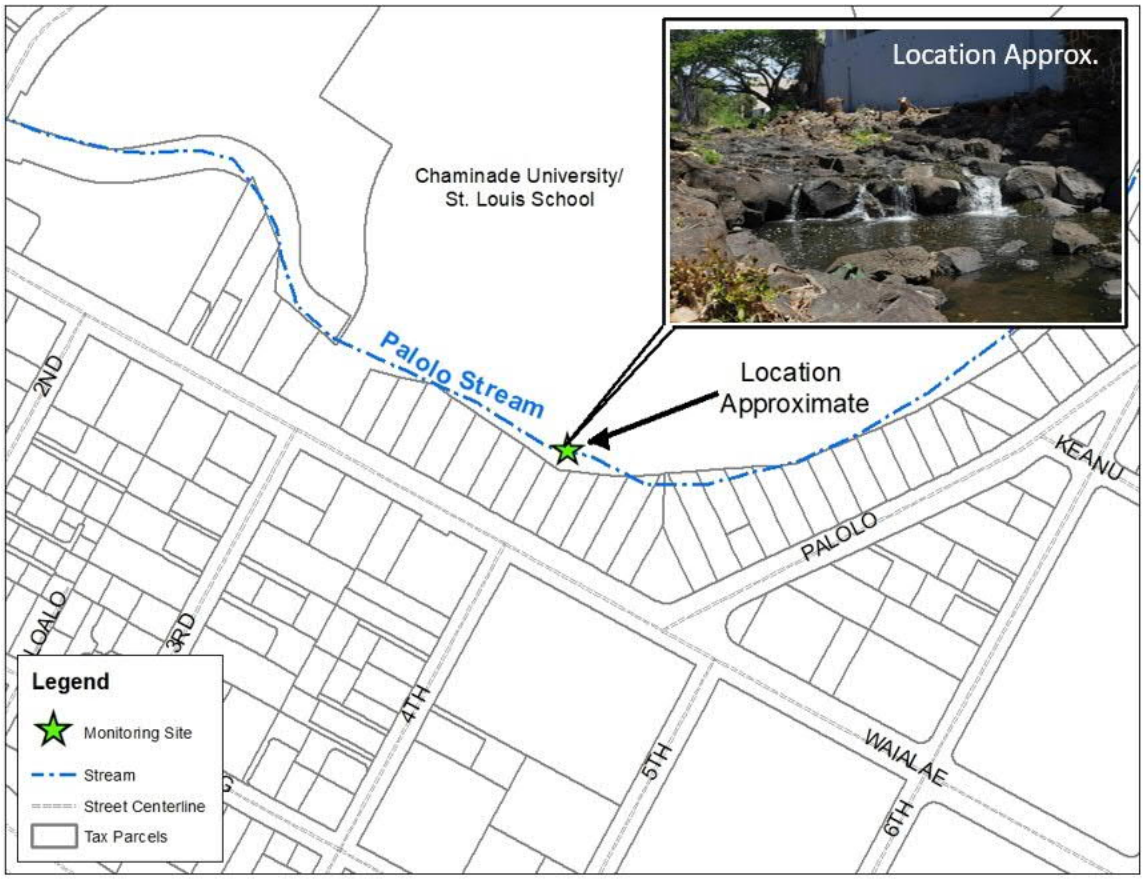


Figure 26: FY24 Palolo Stream Stormwater Monitoring Station at Saint Louis School

Table 6: FY24 Palolo Stream Monitoring Locations for Storm EMC Sampling

Location	Type of Sampling	DA (acres)	Land Use (% of DA)			Ownership
			Urban	Cons.	Ag.	
Kalua Road	Storm EMC	2,035	22%	73%	5%	City
Saint Louis School / Chaminade University	Storm EMC	2,565	35%	61%	4%	Private

DA = Drainage Area
Cons. = Conservation
Ag. = Agriculture
EMC = Event Mean Concentration

A number of other storm sampling stations have been tentatively identified in other portions of Palolo Stream watershed. These will likely be installed in the near future. However, they are not included in this FY24 monitoring plan because the sites are very preliminary and require field verification and funding approvals. ROEs will also need to be obtained before installing any additional stormwater monitoring sites.

The FWP also includes the collection of baseflow samples from Palolo Stream and its tributaries beginning in FY24. These samples will be collected as grab samples at specific transition areas along the stream where site conditions and water quality changes are expected to occur, for example where the channel changes from a natural stream to a concrete channelized stream. Samples will be collected from just above and just below each significant transition. The goal of this approach is to characterize the stream and its tributaries from top to bottom to identify where water quality is most impaired, as well as identify site-specific factors that are contributing to the variation in water quality. Factors like water temperature, shading from trees, channel bottom and substrate, biology, channel confluences, oxygen concentration, groundwater springs, dry weather flow from the MS4, pH, and other conditions can all affect pollutant concentrations. These factors must be understood to identify the optimal places and types of BMPs to implement for effective water quality restoration.

For the baseflow sampling, no fixed monitoring equipment will be left on-site, and all of the samples will be collected by hand directly from Palolo Stream. It is expected that up to approximately fifteen (15) baseflow samples will be collected twice per year from known transition areas in the stream, beginning in the Pukele Stream and Waiomao Stream tributaries in the upper watershed down to the confluence with Manoa Stream at the Koali Road bridge. The exact locations and number of baseflow sampling sites still needs to be field verified and ROE approvals still need to be obtained. A generalized map of potential baseflow sampling sites is shown in **Figure 27**. Note these sites are approximate at the time of the writing of this report.

The baseflow samples will be tested for the same water quality parameters as those listed above for the storm samples. A number of other parameters will also be measured in the field at each baseflow sampling site using a YSI EXO3 Multi-Parameter Water Quality Sonde. The exact parameters are still to be determined but may include: water temperature, salinity, dissolved oxygen (both concentration and percent saturation), pH, and/or turbidity.

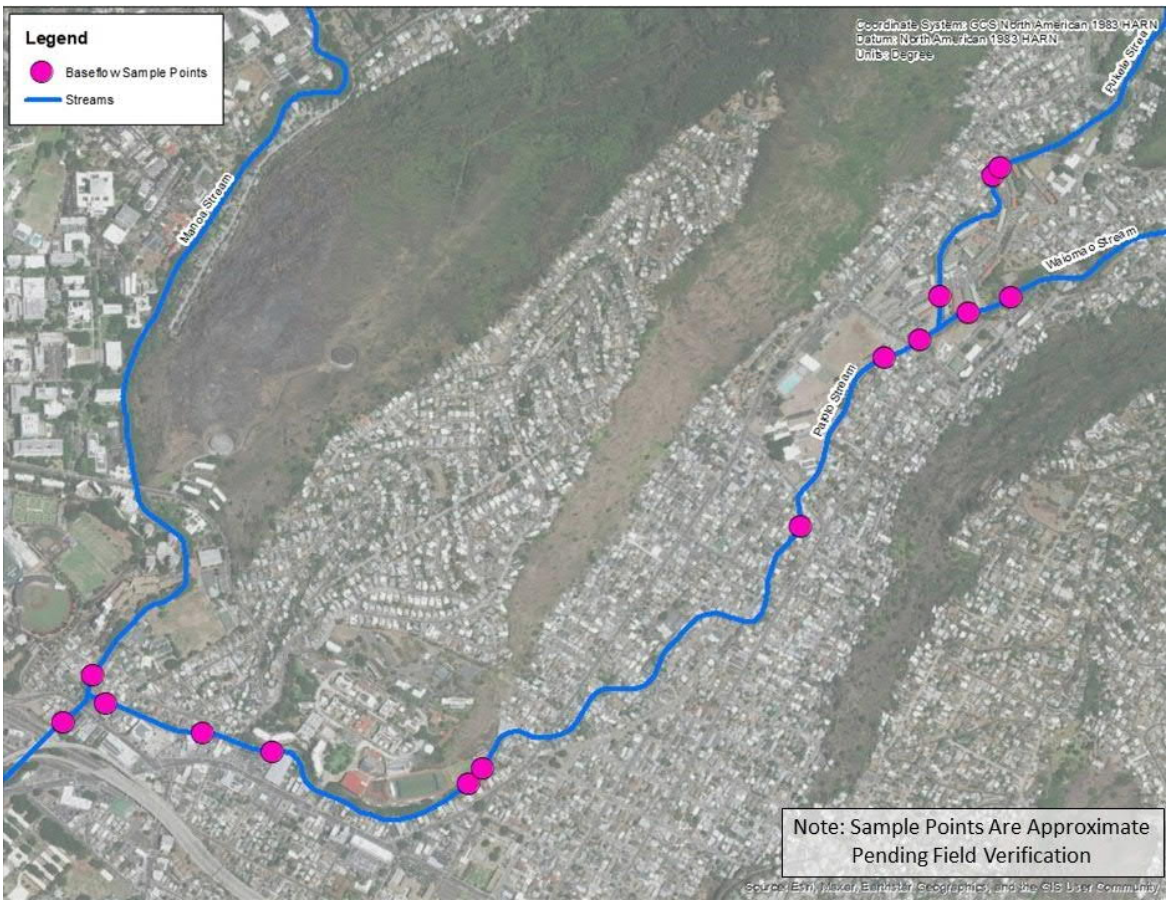


Figure 27: Approximate Locations of Baseflow Sampling Points Along Palolo Stream

G. CITY MUNICIPAL FACILITIES MONITORING PROGRAM

As required by the NPDES MS4 permit for municipal industrial facilities, DFM-SWQ conducts monitoring of select City industrial facilities for representative first flush and flow-weighted composite stormwater samples. DFM-SWQ has developed a priority-based monitoring schedule which places the highest priority on facilities with the greatest potential of pollutant discharge. This process involved assigning a weighted risk score (WRS) to each facility.

The permit requires annual monitoring of storm water at all wastewater treatment plants and closed landfills[1]. Annual storm water monitoring is also required for the facility with the highest WRS for each of the following types of industrial facilities:

[1] In a letter dated February 26, 2021, DOH indicated that "DOH believes that there are no industrial activities occurring at each of the five (5) closed landfills. Therefore, NPDES permit coverage for the closed landfills is not required." Accordingly, the City is in the process of removing the closed landfills from the Permit. The City has suspended monitoring for closed landfills.

- Bus Maintenance Facilities
- Rail Transit Centers, Corporation Yards & Vehicle Maintenance Yards
- Refuse Transfer Stations/ Collection Yards/ Centers.

Per Part F.2 of City's permit, at least two (2) additional facilities from each facility type must be monitored annually, for a total of three (3) facilities per type per year[2]. A total of 14 industrial facilities will be monitored in FY24, as shown in **Table 7**: FY24 City Industrial Facilities Storm Water Sampling Schedule.

Attached for reference is City and County of Honolulu – Department of Facility Maintenance – Monitoring Plan for City Industrial Facilities (**Appendix E**). This document outlines the steps to collect representative storm water samples from the targeted locations to fulfill the monitoring requirements of the MS4 permit. DFM-SWQ is currently following and implementing these procedures for City facility sampling.

[2] There are only two (2) City bus maintenance facilities.

Table 7: FY24 City Industrial Facilities Storm Water Sampling Schedule

#	Facility Name	City Department	Sampling Frequency
Wastewater Treatment Plants			
1	Honouliuli Wastewater Treatment Plant	ENV	Annual
2	Kailua Wastewater Treatment Plant	ENV	Annual
3	Sand Island Wastewater Treatment Plant	ENV	Annual
4	Wahiawa Wastewater Treatment Plant	ENV	Annual
5	Waianae Wastewater Treatment Plant	ENV	Annual
6	Waimanalo Wastewater Treatment Plant	ENV	Annual
Bus Maintenance Facilities			
7	Kalihi-Palama Bus Facility and Paratransit Facility	DTS	Annual
8	Pearl City Bus Facility	DTS	Annual
Rail Transit Centers, Corporation Yards & Vehicle Maintenance Yards			
9	Halawa (AES) Corporation Yard	DFM	Annual
10	Manana (DPR-MSS) Corporation Yard	DFM	Rotational*
11	Pearl City (AES) Corporation Yard	DFM	Rotational*
Refuse Transfer Stations/ Collection Yards/ Centers			
12	Keehi Refuse Transfer Station	ENV	Annual
13	Waimanalo Refuse Convenience Center	ENV	Rotational*
14	Laie Refuse Convenience Center	ENV	Rotational*

*These facilities were sampled in FY23 and exceeded numeric effluent limitations. DFM-SWQ continues to re-sample these facilities on a quarterly basis as the City works to resolve these exceedances. Other facilities will be rotated into this list in FY24 if the exceedances at FY23 rotational facilities have been resolved by that time.

H. TRASH REDUCTION MONITORING PLAN

As required under the NPDES MS4 Permit, Part D.1.f.(1).(vii), the City developed the 2020 Short-Term Trash Reduction Plan to reduce trash discharging from the City's MS4 by 50% of the baseline load by June 30, 2023. The City completed a Trash Baseline Load Study (BLS) in 2017 to determine the baseline volume of trash discharged from the City's MS4. The BLS included a trash visual assessment to evaluate the amount of the trash on the street level. The City will continue to implement the Short-Term Trash Reduction Plan in FY24 while developing a Long-Term Reduction Plan to reduce trash discharging from the City's MS4 by 100% of the baseline load by June 30, 2034.

There are four visual assessment scores: low, medium, high, and hot spot. The BLS found a high correlation between visual assessment scores and trash loading rates. Visual assessments were used to fine tune the baseline load and will continue in the future to determine the effectiveness of Trash Management BMPs. The effectiveness of full capture BMPs will be added to the Post-Construction BMP Inspection Program in the future.

The frequency of visual assessments is based on priority; segments with a higher baseline trash visual assessment score are inspected more often to confirm that trash reduction BMPs are effective. Inspection frequencies are shown in **Table 8**. All segments will be inspected at least once per permit term.

Table 8: Visual Inspection Frequency

Visual Assessment Score	Low	Medium	High	Hot Spot
Inspection Frequency	Once per Permit Term	Bi-Annually (2x per year)	Quarterly	Monthly
Number of Segments*	13,723	1,119	150	90

*Subject to change as the program progresses and BMPs are implemented.

I. STREET SWEEPING PILOT STUDY

The City implemented a street sweeping pilot study between July 2012 and February 2017 in the TMDL watersheds to develop a methodology to quantify pollutant removal of TSS, TN, and TP from its routine street sweeping operations. The City measured the volume of material collected per sweeping route, analyzed the material for nutrient content and particle size distribution, and converted the volume to a mass of pollutant via EPA-published bulk density conversion factors. The data gathered to date have allowed the City to quantitatively determine the mass of sediments and nutrients that are removed by its street sweeping operations and to assess compliance with its WLA reductions. A report summarizing the results of the laboratory analysis and data collected was submitted to the DOH in FY18. That report provides the basis on which the City currently estimates its pollutant removals via street sweeping operations in the TMDL watersheds.

Since the conclusion of the initial study, the City has expanded the pilot study to include other areas of the island beyond the TMDL watersheds. Since the beginning of FY18, the City has

quantified and analyzed pollutant removals in street sweeping routes from West Oahu to Hawaii Kai, and has expanded coverage in windward areas.

In FY23, the City submitted a final report summarizing the street sweeping pilot study in Mililani (a portion of the Waikele Stream TMDL), non-TMDL watersheds of Kailua, and non-TMDL watersheds of Pearl City. The pilot study is expected to continue in non-TMDL areas of Kaneohe and other rural areas of Oahu in FY24.

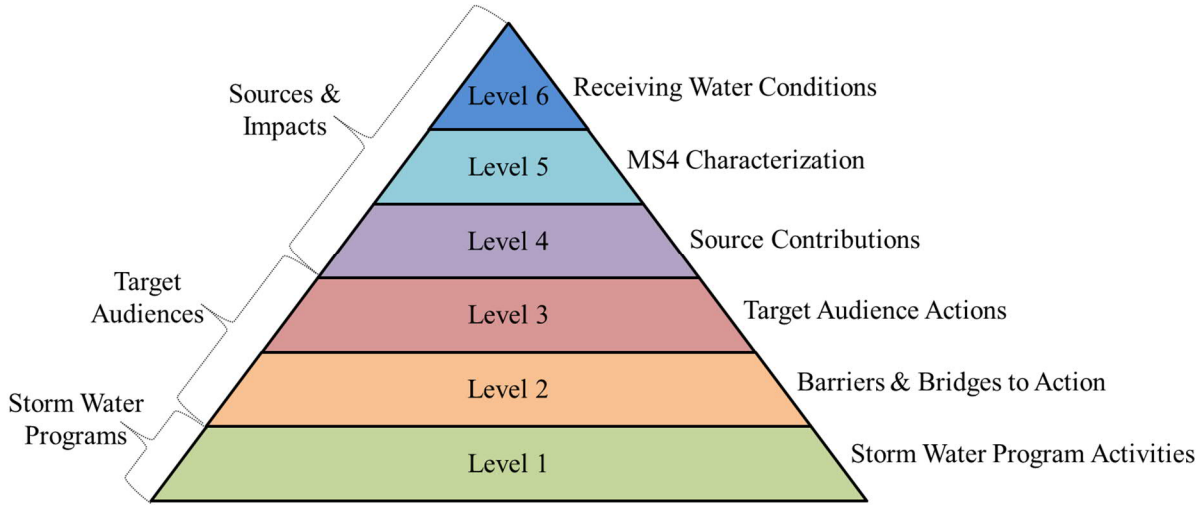
J. STORM WATER MANAGEMENT PROGRAM (SWMP) EFFECTIVENESS PLAN

As required in the City's NPDES MS4 Permit, the City will continue to implement a strategy for determining the effectiveness of its SWMP. The City revised its 2021 SWMPP and Program Effectiveness Assessment Plan (PEAP) which was submitted to the DOH on September 1, 2021. The PEAP includes a written strategy for determining the effectiveness of the SWMP, including a chapter on monitoring as it relates to the Permit. A copy of the PEAP from the City's 2021 SWMPP (Chapter 12) is included in **Appendix F**.

Below are excerpts from the SWMPP Program Effectiveness Plan that are proposed strategies for assessing the City's MS4 effectiveness in terms of water quality improvements.

In an effort to evaluate the progress of program implementation and the performance of BMPs, this plan has been revised to: (1) measure progress of permit compliance and implementation of BMPs, (2) track program component effectiveness over the permit period, and (3) set the frame work to be able to link program implementation with environmental improvements over time.

This PEAP has been developed to incorporate elements of the California Stormwater Quality Association (CASQA) approach to program effectiveness assessment as detailed in their 2007 and 2015 manuals. The approach is based on different outcomes that result from implementing storm water management programs. Outcomes are the results of implementing a storm water control measure, program activity or overall program. These outcomes are characterized into six (6) Outcome Levels which are represented below as a pyramid in **Figure 28** which has been adapted from CASQA. The pyramid structure illustrates the progression from implementing activities to protecting water quality. In general, Outcome Levels 1 through 4 are implementation-based outcomes which describe program activities, while Outcome Levels 5 and 6 are based on water quality and are more difficult to measure. Outcome Levels help categorize and define the desired results or goals of programs and control measures.



Note: This figure has been adapted from the CASQA 2007 and 2015 approaches to program effectiveness assessment.

Figure 28: Program Effectiveness Outcome Levels

Most program assessment will be conducted at the implementation level (Outcome Levels 1 through 4). Water quality assessments (Outcome Levels 5 and 6) are conducted as part of the City's ongoing Annual Monitoring program. Over time, with both sets of data, the City will explore the connections between program implementation and water quality changes in a process called Integrated Assessment.

The Program Effectiveness Assessment Plan (Chapter 12 from the 2021 SWMPP) has been included as an attachment to this report under **Appendix F**.

The overarching goal for the monitoring conducted by the City relates to both managing and assessing the effectiveness of the SWMPP. The primary objective of the SWMPP is to reduce pollutants discharged from the MS4 to receiving waters to the Maximum Extent Practicable (MEP), and monitoring results can support decisions made by the City to fine-tune the SWMP to meet its primary objective. Therefore, the purpose of the Effectiveness Monitoring Program is both to meet the requirements of the MS4 Permit and address key management questions.

Figure 29 presents the framework for how these data will be used to measure the effectiveness of the SWMPP. The figure illustrates how the data will be used to determine when BMPs need to be revised, continue as-is, or even be reduced/eliminated. This strategy will allow the City to manage its limited resources as efficiently and effectively as possible. The decision flowchart uses three pieces of information to determine if the program is effective and if the SWMPP needs to be revised:

- If water quality standards were exceeded.
- If the historical trend indicates an improvement or degradation in water quality.
- If the City's MS4 is the primary cause of the exceedance.

Whether or not a change to the SWMPP or Monitoring Plan is warranted depends on the answer to each question. For example, if water quality standards were exceeded, the pollutant concentrations are not decreasing over time, and the City's MS4 is the primary cause of the exceedance, then it can be concluded that the BMPs in place within that particular watershed are not sufficient, and the SWMPP and/or Monitoring Plan will be revised in an effort to address the issue. On the other hand, if water quality standards were not exceeded and the pollutant concentrations are decreasing over time, then it can be concluded that the BMPs in place within that particular watershed are effective, and an assessment will be made to determine if they can be reduced or eliminated.

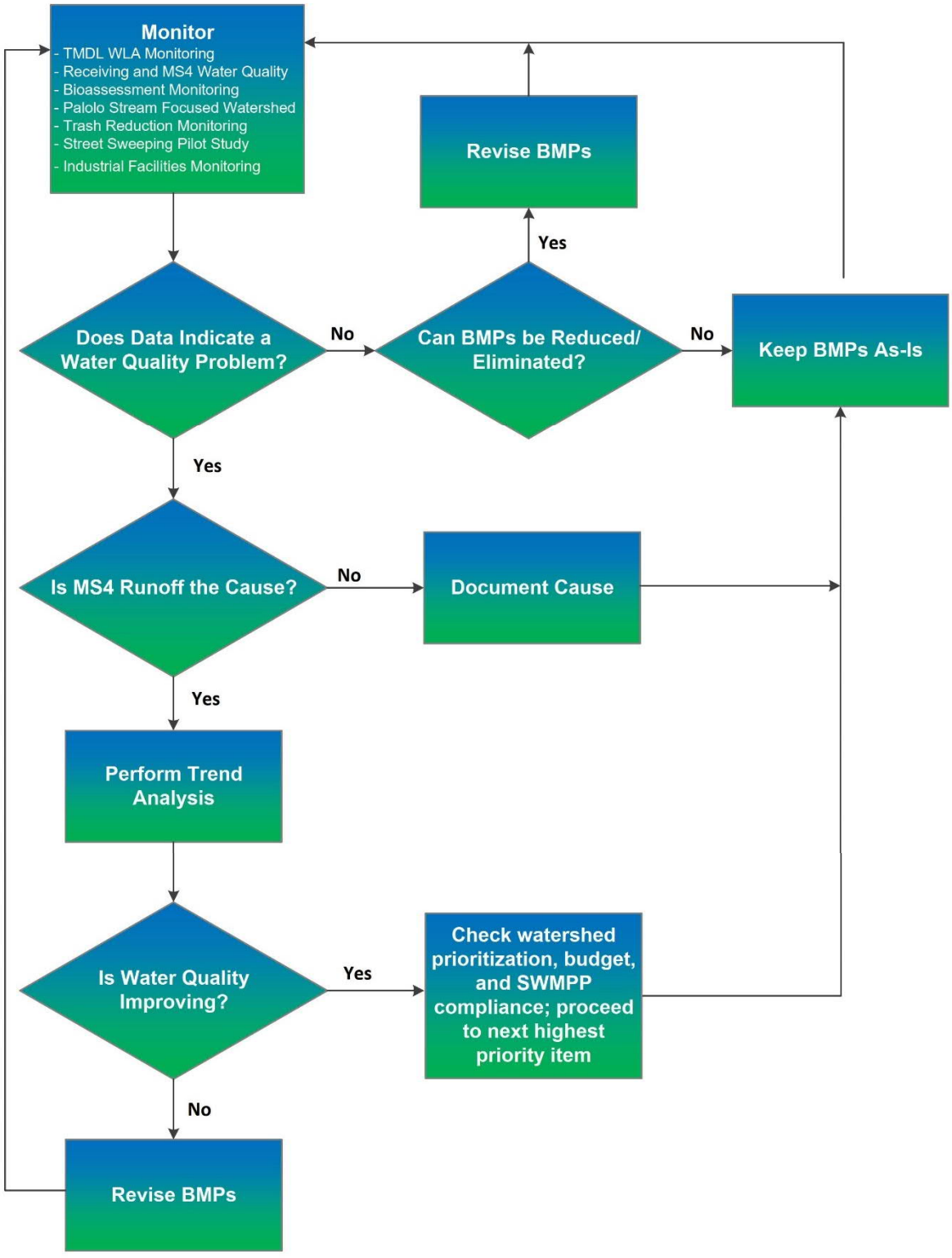


Figure 29: Water Quality Monitoring SWMP Effectiveness Assessment Matrix

III. ANALYTICAL METHODS

As contracted by the DFM-SWQ, ALS Environmental, Inc. is expected to continue providing laboratory testing services of storm water samples delivered to them by the DFM-SWQ personnel. However, this may be subject to change based on rates charged by the contract laboratory or other circumstances. A list of the sampling parameters, their respective test methods, holding times, container descriptions, and preservation requirements are shown in **Table 9** below. If, for any reason, the DFM-SWQ decides to switch testing laboratories, the same procedures and test methods described in **Table 9** will continue to be followed. Further detailed information for individual parameters may be obtained upon request through ALS Environmental, Inc.

Table 9: Analytes and Sample Methods (ALS Environmental)

Analyte	Test Method *	Holding Time*	Container*	Preservation*
Biochemical Oxygen Demand (5-day)	SM 5210 B	48 hrs.	1 L G or P	<4°C
Chemical Oxygen Demand	SM 5220 B	28 days	1 L G or P	H_2SO_4 to pH < 2, <4°C
Total Suspended Solids	SM 2540 D	7 days	1 L G or P	<4°C
Total Kjeldahl Nitrogen	ASTM D1426-08B	28 days	500 ml G or P	H_2SO_4 to pH < 2, <4°C
Nitrate+Nitrite as Nitrogen	EPA 300	28 days	100 ml G or P	H_2SO_4 to pH < 2, <4°C
Total Nitrogen	SM 4500	28 days	500 ml G or P	H_2SO_4 to pH < 2, <4°C
Total Phosphorus	EPA 365.3	28 days	250 ml G or P	H_2SO_4 to pH < 2, <4°C
Ammonia Nitrogen	SM 4500-NH	28 days	1 L G or P	H_2SO_4 to pH < 2, <4°C
Orthophosphates	EPA 365.3	48 hrs.	250 ml G or P	H_2SO_4 to pH < 2, <4°C
Conductivity	EPA 120.1	28 days	250 ml G or P	<4°C
Turbidity	EPA 180.1	48 hrs.	1 L G or P	<4°C
Oil and Grease	EPA 1664A	28 days	1000 ml G only	HCl to pH < 2, <4°C
Enterococci	EPA 1600	6 hrs.	500 ml G or P	<4°C
Copper	EPA 200.8	6 months	500 ml P	HNO_3 to pH < 2
Zinc	EPA 200.8	6 months	500 ml P	HNO_3 to pH < 2
Iron	EPA 200.7	6 months	500 ml P	HNO_3 to pH < 2

* EPA Methods for Chemical Analysis of Water and Wastewater (April 2007)

IV. QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Accurate and reliable data are required by the DFM-SWQ to meet the standards set by State and/or Federal regulations. Since engineering and environmental decisions are based on the data produced, it is essential that clear and extensive verification procedures be established. Currently, ALS Environmental, Inc. provides the DFM-SWQ with the laboratory expertise for storm water monitoring analyses. As part of the Permit, the DFM-SWQ requested the contract laboratory provide a written Quality Assurance/Quality Control (QA/QC) document. This document includes the following items:

- Company Overview (scope and goals of the company)
- Organization
- Certification
- Professional Staff
- Equipment and Facilities
- Sample Handling and Procedures
- Analytical Quality Control
- Data Validation and Reporting
- Documentation
- Quality Assurance

The document serves as a written agreement that ensures and validates the quality of the data packages received. A copy of the QA/QC manual for ALS Environmental is attached in **Appendix A**.

The USGS QA Plan which describes the various operations and organizations within the USGS and their roles in the suggested quality control practices for obtaining sediment data is included in **Appendix B**. The USGS QA/QC guidelines for the determination of sediment concentration by USGS sediment laboratories is included as **Appendix C**. The guidelines are directed toward the use of acceptable laboratory procedures for the processing and analysis of suspended-sediment samples and the documentation of QA practices.

The DFM-SWQ also has a QA plan and procedure for sampling using the YSI Multi- Parameter Water Quality Sonde and monitoring procedures for storm water sampling at City industrial facilities. A copy of the YSI QA Monitoring Plan is included in **Appendix D.**

The DFM's Monitoring Plan for City Industrial Facilities is included in **Appendix E**.

A copy of the Quality Assurance Project Plan for City and County of Honolulu NPDES MS4 End-of-Pipe and Stream Monitoring Program (May 2021) is included in **Appendix G.**

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V. ESTIMATED FY24 MONITORING BUDGET

For FY24, the projected expenditures are estimated to be approximately $2,518,000. This includes, but is not limited to, the quarterly stream sampling and analysis involving the use of YSI monitoring probes, water quality lab analyses, suspended sediment sampling, planning and initiation of an island-wide biological assessment program, island-wide watershed modeling, trash reduction monitoring, municipal facilities monitoring, Palolo Stream focused watershed plan, efforts to develop and/or revise existing Implementation and Monitoring plans to address the seven (7) WLAs described in the City's NPDES MS4 Permit, BMP and TMDL tracking activities, and other partnership monitoring efforts. Additionally, the Ala Wai, Waikele, Honouliuli, Waialua-Kaiaka, Salt Lake, and Kaelepulu watershed management studies have been included in the overall monitoring budget. Projected expenditures are subject to approval by the City Council. It should also be noted that budgets are subject to change based on MS4 Permit negotiations and program activities that are revised to be consistent with Permit conditions.

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